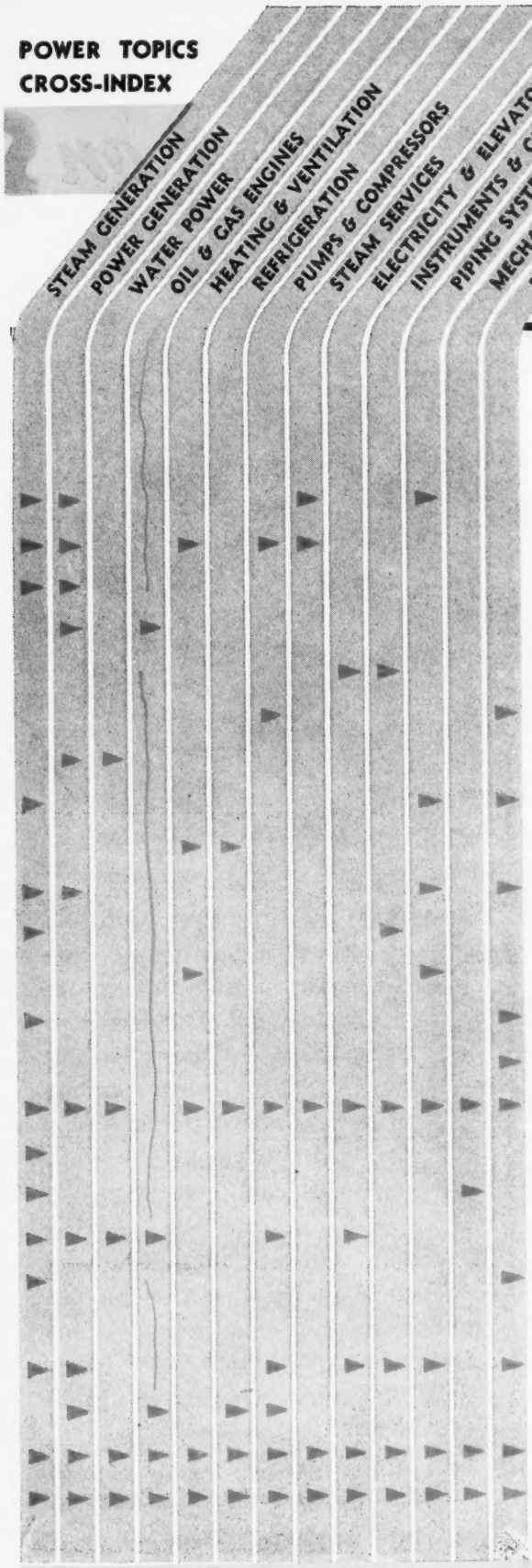

Volume 79 Number 1

POWER

MASON BRITTON, *Vice-president* — N. O. WYNKOOP, *Manager*

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January, 1935

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McGRAW-HILL PUBLISHING COMPANY, INC., 330 WEST 42d STREET, NEW YORK, N. Y.

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GREENVILLE, S. C., 1301 Woodside Bldg.
LONDON, Aldwych House, Aldwych, London, W.C.2

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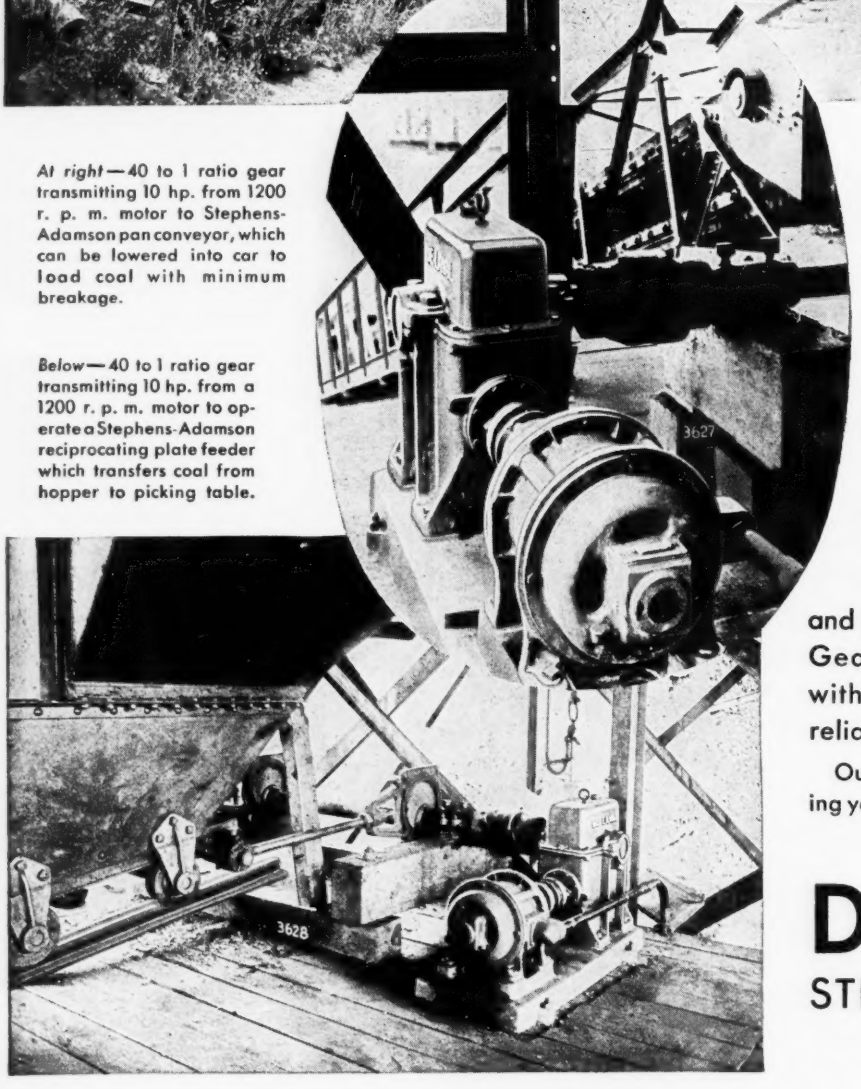
DE LAVAL WORM GEARS

Save Money on HEAVY WORK

At right—40 to 1 ratio gear transmitting 10 hp. from 1200 r. p. m. motor to Stephens-Adamson pan conveyor, which can be lowered into car to load coal with minimum breakage.

Below—40 to 1 ratio gear transmitting 10 hp. from a 1200 r. p. m. motor to operate a Stephens-Adamson reciprocating plate feeder which transfers coal from hopper to picking table.



IMPROVED coal handling machinery motor driven through De Laval worm reduction gears at this mine tipple saves $150 per operating day by reducing the percentage of slack coal and by increasing handling efficiency.

Correct cutting of the gears and liberal bearings, together with automatic lubrication and complete protection against grit and moisture, enable De Laval Worm Gears to carry heavy shock loads with high efficiency and complete reliability.

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POWER

A McGraw-Hill Publication—Established 1884

PHILIP W. SWAIN, *Editor*
January, 1935—Vol. 79, No. 1

IN SPITE OF HELL AND HIGH WATER

● EACH DEPRESSION YEAR has been christened with a barrage of editorials predicting better days ahead. These rosy pictures become a public nuisance; the editorial writers never get a break from the facts of life, except for some measurable improvement in 1934.

● YET EVEN EDITORS CAN LEARN from experience, given enough of it, so we say goodbye to all that, and make no attempt here to anticipate the net result of the thousand and one moving factors in the national situation.

● RECENT BUSINESS IMPROVEMENTS and many signs of a rosier dawn strongly tempt us to cast off the mooring line, but nevertheless we shall stay hitched to provable facts and leave prophecy to those who will risk it.

● LET'S TALK, THEN, OF WHAT WE KNOW. If and when better days come, the bulk of us will move ahead with them, but not all together. If, on the other hand, business improvement drags, the bulk of us will drag along with it, but again not all on the same low level.

● WE MIGHT AS WELL FACE THE FACT that no lone engineer can make much of a dent on the national situation by his single-handed efforts. But, just as certainly, he can, single-handed, produce a very definite effect on his own personal fortunes by jacking the curve of his private performance well above the average, whatever that may be.

● IT WAS DONE BY SOME in 1933 and 1934, notably in certain leading process-industry plants. Others will do it in 1935. And by no magic; merely by the common-sense application of long-established principles.

● IT IS NOT OUR FUNCTION to tell the reader, as part of a manufacturing organization, how to sell more goods at better prices. It *is* our job to show how he may reduce manufacturing costs and thereby increase profits.

● THOSE COSTS THAT ARE the direct responsibility of the power engineer in industry run, in general, from 3 to 10 per cent of the total manufacturing cost. On the average, they are about double what they would be if all plants were as well equipped as the best.

● READ, IN THE REVIEW THAT FOLLOWS, what some have done in 1934. Then study your own plant systematically from coal bills and rate schedules right through to the power-service wastes in maladjusted heating systems, wide-open process valves and misfit motor applications. Figure the total effect of a real modernization of equipment and operating methods.

● YOUR PARTICULAR PLANT may not be wasting fifty cents of each power dollar—it may be twenty cents or sixty. But whatever it may be, it is the measure of a personal opportunity that is little influenced by the "hell and high water" of national economics and business cycles—the chance to add a large and predictable sum to net earnings—the chance to swell the "makings" of future wages and salaries in your own bailiwick.

STEAM PLANTS

By R. B. Purdy
Associate Editor

Higher pressures in industrial plants, together with modernization and "tops" feature a year almost devoid of central station construction. Two 1,200-lb. additions made on industrial power plants

IN SPITE of the almost entire absence of central station construction, 1934 showed continued power-plant progress. This was evidenced by the outstanding modernizations and plant additions placed in operation or under construction in industrial power plants. During 1934 construction started on 1,200-lb. additions to two industrial plants. Ten industrials installed power equipment in the 500- to 1,200-lb. pressure range, and detailed information was secured on nine other industrial power plants of 1934 that will operate between 400 and 500 lb. pressure. This large number of high-pressure industrial installations surely indicates an increased willingness on the part of industrial engineers to accept high pressures when the ratio of power and process steam requirements justifies their use on economic grounds. The wide variation of pressure and temperatures employed in industrial power plants, as indicated in the table of 1934 construction, illustrates how different the industrial power plant problems are from those of central stations.

The only central station capacity of any magnitude to go into operation last year was a 30,000-kw. unit in the Connors Creek plant of Detroit Edison Co. The modernization program at this plant calls for changing steam conditions from 225 lb. and 585 deg. to 710 lb. and 850 deg. Three of the original 20,000-kw. turbines in this plant have been removed, and parts of them are being used in the construction of three new 30,000-kw. units that will be installed on the same foundation and will use the same auxiliaries as the original 20,000-kw. machine. The four new boilers to supply steam to the new unit will have a maximum steam capacity of 435,000 lb. each, and will be fired by underfeed stokers with automatic zone air control. By raising the pressures at this plant, an increase of 50 per cent in capacity will be made possible without the necessity of installing new turbine auxiliary equipment, while at the same time the plant will be modernized.

Only one new central station was under construction during the year. This is the Port Washington Station of Milwaukee Electric Railway & Light Co., which is expected to go into operation this year with an initial capacity of 80,000 kw. Steam will be supplied to the single turbine by a pulverized coal-fired boiler at 1,390 lb. pressure and 850 deg. temperature. The plant will operate on a reheat regenerative cycle. The pulverized-coal fired boiler is designed for a maximum output of 690,000 lb. per hr., and equipped with a combination superheater and radiant reheater, giving automatic control of superheat and reheat temperature.

The new 165,000-kw. addition to Richmond Station of Philadelphia Electric Co. is expected to go into operation early this year. Steam will be supplied by two new 600,000-lb. per hr. boilers at 400 lb. pressure and 850 deg. temperature. The slag-bottom furnaces will be completely water-cooled and fired with a modified bin system of pulverized coal, in which sufficient fuel will be stored for about five hours maximum boiler operation. The tandem-compound turbine will be served by a 113,000-sq.ft. single-pass condenser.

THE two 1,200-lb. industrial installations previously mentioned are additions to the power plants serving Ford Motor Co., Detroit, Mich., and Firestone Tire & Rubber Co., Akron, Ohio. Late in August Ford announced the purchase of a 110,000-kw. addition to his River Rouge power plant. The new 1,200-lb. vertical-compound unit is similar to that previously installed at this plant, except that it is designed to operate with steam at 900 deg. F. Because of this high initial temperature, steam will not be reheated before passing to the low-pressure unit. It is the first 1,200-lb. turbine unit in the United States designed for this high temperature, and without provisions for reheating the steam. The 800,000-lb. per hour boiler supplying this turbine is the largest steam-generating unit ever built for 1,400 lb. pressure. It is to be fired by pulverized coal, and both economizers and air preheaters will be installed.

With the Ford installation temperature limits are raised to 900 deg., which, it appears, will sound the knell of reheat plants operating in this pressure range. Whether still higher pressures, of the order of 2,000 to 3,000 lb., with reheat will be used must be determined

by an economic study of costs and savings. It should be noted that an American manufacturer has obtained a license to sell and develop the Benson boiler and that another company is ready to furnish standard boilers for 2,500 lb. pressure.

At Firestone a 1,400-lb. "top" is being installed on the present plant. The new high-pressure boiler will deliver 300,000 lb. of steam per hr. at 1,400 lb. pressure and 760 deg. to a new 10,000-kw. back-pressure turbine designed to exhaust to evaporators at 250 lb. pressure. The boilers will be fired with pulverized coal, and air preheaters and economizers provided for heat recovery. Boiler drums are 54 in. in diameter, 23 ft. long, and 4 in. thick, and are the largest fusion-welded drums so far constructed. Five evaporators, each of 52,000 lb. per hr. capacity, will condense turbine exhaust.

One of the outstanding additions to be placed in operation during 1934 is the 800-lb., 750-deg. "top" at Goodyear. The new 7,500-kw. turbine is arranged for extracting 150,000 lb. of steam per hr. at 200-lb. pressure for use by the old turbines. It may also operate as a straight non-condensing unit supplying 100-lb. steam for process use. One new cross-drum pulverized fuel fired boiler, with a maximum capacity of 300,000 lb. per hr., supplies the required high-pressure steam. The old low-pressure boilers have been kept for standby service. Air preheaters are installed with bypass so that 50 per cent of maximum rating can be carried by natural draft in case of induced-draft fan failure. Coal is fired through four cross-tube burners. A slag-bottom furnace provides for a heat liberation of 32,700 B.t.u. per cu.ft.

At Bayway a second 300,000-lb. per hr., 650-lb. pressure boiler was placed in operation. The unit is unique, because it is specially designed for firing with pulverized fuel, refinery wastes and gas.

Repeal of prohibition has made it necessary for brewers and distillers to build new plants or modernize their old ones. Some of the outstanding examples of 1934 power plant construction in this industry are Hiram Walker & Sons' new distillery at Peoria, Ill., Hamm Brewing Co., St. Paul, Minn., and the Century Distilling Co., Peoria, Ill. None of these is a high-pressure plant, since the process steam requirements are large relative to power requirements.

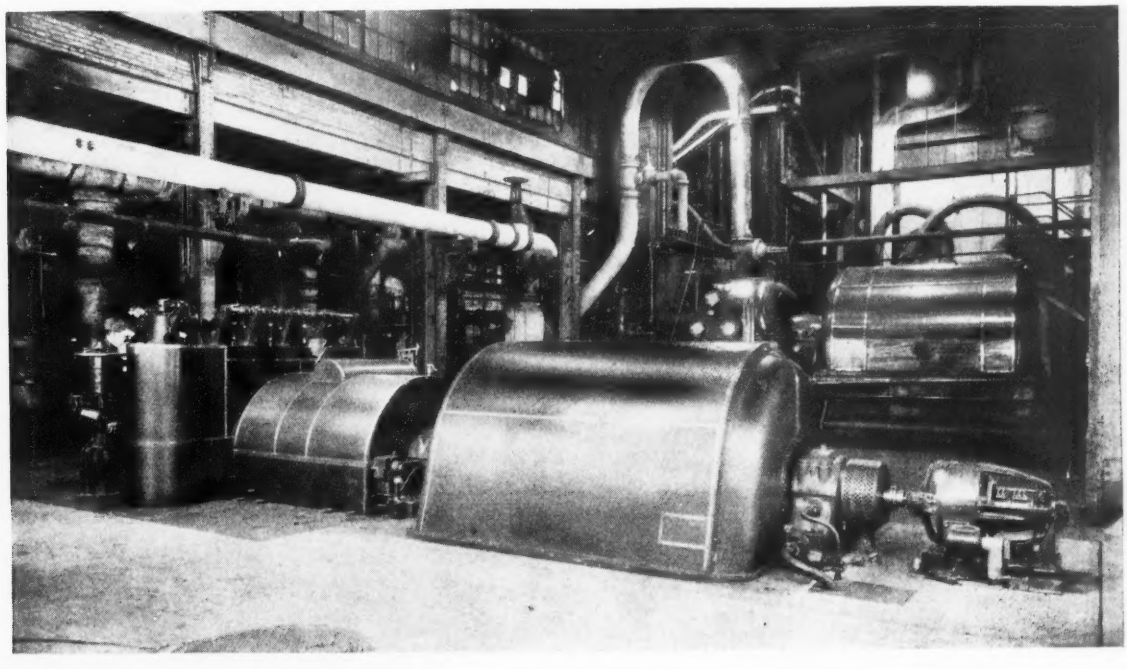
The power plant for the new Hiram Walker distillery contains two boilers of 180,000-lb. per hr. capacity fired with pulverized fuel. Steam is delivered at 230 lb. pressure and 510 deg. to two 1,500-kw., 3,600-r.p.m. turbines. Steam is bled at 75 lb. pressure and exhausts at 15 lb. for process use.

In modernizing its power facilities, Hamm Brewing Co. built a new power plant in which some of the equipment from the old plant, such as refrigeration machinery, was used. Two new 1,000-kw. automatic extraction condensing turbines were installed, one of which will carry the present load. Steam is extracted at 60-lb. pressure for cooking and other process. Three new stoker-fired boilers with a maximum steaming capacity of 45,000 lb. per hr. operate at 280 lb. pressure.

THERE has apparently been a decrease in power plant construction for institutions, and likewise relatively little new municipal capacity went into operation during the past year. About eleven municipalities have let orders for new steam plant capacity, totalling to about 31,000 kw.

Central station output increased steadily throughout 1934, ending the year with a weekly generation of 1,695,000,000 kw.-hr. This is above the output of 1931 for the same week and only 11 per cent below the all-time peak of 1,860,000,000 kw.-hr. in 1929. The output of all public utilities for 1934 was 90,140,000,000 kw.-hr., an increase of 5.5 per cent over 1933 generation.

New 7,500-kw. turbine at Goodyear Tire & Rubber Co.



STEAM PLANTS PLACED IN OPERATION

Company	Location	Pressure, Lb. Per Sq. In.	Temperature, Deg. F.	No. of Boilers	Steaming Capacity, Lb. Per Hr. Each	Boiler Heating Surface, Sq. Ft.	Water Wall Surface, Sq. Ft.	Econo-mizer Number	Econo-mizer Surface, Sq. Ft.	Air Preheater Number	Air Preheater Surface, Sq. Ft.	Furnace Volume, Cu. Ft.	Method of Firing
CENTRAL STATION PLANTS													
Milwaukee Electric Railway & Light Co.	Port Washington	1,390	840	1	690,000	44,100	7,710	..	.....	2	60,500	58,000	Bin P. C.
Detroit Edison Co.	Conners Creek	710	850	4	435,000	24,920	2,836	2	8,640	4	14,450	11,100	U. Stoker
Philadelphia Electric Co.	Richmond	425	850	2	600,000	36,200	4,648	..	.....	2	48,000	26,900	P. C.
Columbus Railway Power & Light Co.	Picway	400	750	1	300,000	18,300	6,870	1	6,770	1	28,200	.....	P. C.
Triangle Heating Plant	Washington, D. C.	200	Sat.	6	205,000	25,243	....	..	.....	..	.....	.....	U. Stoker
Abington Electric Co.	Clark Sumit, Pa.	....	...	..	.....	.....	....	..	.....	..	.....	.....	.....
Virginia Public Service Co.	Hampton, Va.	....	...	..	.....	.....	....	..	.....	..	.....	.....	.....
INDUSTRIAL PLANTS													
Firestone Tire & Rubber Co.	Akron, Ohio	1,400	760	1	300,000	11,793	7,584	1	8,110	1	23,100	14,500	P. C.
Ford Motor Co.	Dearborn, Mich.	1,200	900	1	800,000	30,000	7,125	1	26,500	2	86,000	29,000	P. C.
Goodyear Tire & Rubber Co.	Akron, Ohio	800	745	1	300,000	20,131	2,776	..	.....	1	33,400	.....	P. C.
Tide Water Oil	Bayonne, N. J.	713	760	3	100,000	.....	.....	..	.....	..	.....	.....	Oil
Firestone Tire & Rubber	Los Angeles, Cal.	710	700	1	.....	8,430	650	1	11,780	1	14,000	7,350	Oil & Gas
Standard Oil Co. of N. J.	Bayway, N. J.	650	740	1	300,000	15,000	....	1	14,100	..	.....	17,000	Oil & P. C.
West Va. Pulp & Paper Co.	Piedmont, W. Va.	636	750	1	400,000	15,600	6,500	..	.....	1	40,000	18,000	P. C.
Standard Oil Co. of N. J.	Canton, Md.	600	700	..	.....	.....	.....	..	.....	..	.....	.....	.....
West Va. Pulp & Paper Co.	Covington, Va.	600	750	1	400,000	15,600	6,500	..	.....	1	40,000	18,200	P. C.
Westinghouse Air Brake Co.	Wilmerding, Pa.	600	700	2	67,500	7,570	442	..	.....	..	.....	.....	U. Stoker
E. I. du Pont de Nemours & Co.	Parlin, N. J.	550	700	1	75,000	7,430	1445	..	.....	1	7,460	4,210	P. C.
Container Corp. of Am.	Manayunk, Pa.	500	625	1	200,000	12,610	4,230	..	.....	1	16,800	9,600	P. C.
Dow Chemical Co.	Midland, Mich.	490	725	1	35,000	26,700	4,700	1	13,000	..	68,800	22,000	P. C. & Oil
General Aniline Works	Grasselli, N. J.	450	650	2	65,000	4,650	1,900	..	.....	2	6,509	3,400	.....
Hershey Chocolate Corp.	Hershey, Pa.	450	650	3	150,000	11,200	1,448	..	.....	3	19,300	8,300	P. C.
Byron Weston Co.	Dalton, Mass.	450	650	1	35,000	4,313	....	..	.....	1	4,116	1,570	P. C.
Titanium Pigment	Sayreville, N. J.	450	640	2	125,000	.....	....	..	.....	..	.....	.....	P. C.
Independent Oil & Gas Co.	Kansas City	450	610	3	46,800	5,200	....	..	.....	..	.....	2,900	Oil & Gas
Homestake Mining Co.	Kirk, S. D.	448	700	3	81,000	10,000	237	3	2,880	..	.....	3,400	Stoker
Colgate-Palmolive-Peet Co.	Jeffersonville, Ind.	425	590	1	35,000	4,100	380	1	1,950	..	.....	1,350	Chain Grate
Fort Howard Paper Co.	Green Bay, Wisc.	420	600	1	100,000	10,000	....	..	.....	..	.....	.....	U. Stoker
Wilson & Co.	Chicago, Ill.	420	550	3	140,000	11,220	1,570	3	4,830	3	13,788	10,200	P. C.
Pennsylvania Salt Mfg. Co.	Wyandotte, Mich.	400	700	1	150,000	14,420	2,600	..	.....	1	23,200	10,000	P. C.
Clinton Cotton Mills	Clinton, S. C.	400	725	2	40,000	4,673	....	..	.....	..	.....	1,700	P. C.
American Enka Co.	Enka, N. C.	350	675	1	90,000	8,200	1,230	..	.....	1	7,700	4,170	P. C.
Appleton Co.	Anderson, S. C.	300	550	..	.....	.....	....	..	.....	..	.....	.....	.....
Hamm Brewing Co.	St. Paul, Minn.	300	600	3	45,000	.....	.....	..	.....	3	5,160	.....	U. Stoker
Kalamazoo Vegetable Parchment Co.	Parchment, Mich.	275	650	1	160,000	10,360	3,380	}	.....	1	16,000	8,250	P. C.
Pennsylvania Railroad	West Philadelphia	275	Sat.	1	276,000	26,811	1,291	..	.....	..	.....	8,600	U. Stoker
Fleischmann Malting Co.	Minneapolis, Minn.	250	Sat.	3	.....	7,500	....	..	.....	..	.....	.....	Oil
Hamilton Woolen Co., Inc.	Southbridge, Mass.	250	407	1	70,000	6,680	854	..	.....	..	.....	3,200	P. C.
Iowa Soap Co.	Camden, N. J.	250	Sat.	2	35,000	5,500	....	..	.....	..	.....	900	Stoker
Peter Cailler Kohler Swiss Chocolate Co.	Fulton, N. Y.	250	Sat.	1	70,000	6,000	....	..	.....	..	.....	.....	U. Stoker
Hiram Walker & Sons, Inc.	Peoria, Ill.	230	509	2	180,000	13,790	2,246	..	.....	2	14,500	7,430	P. C.
Diamond Match Co.	Barberton, Ohio	225	Sat.	2	30,000	.....	....	..	.....	..	.....	.....	P. C.
Freedom Oil Works Co.	Freedom, Pa.	200	488	1	52,800	5,510	....	..	.....	..	.....	1,700	Chain Grate
Syracuse Chilled Plow Co.	Syracuse, N. Y.	200	Sat.	1	20,000	3,600	....	..	.....	..	.....	.....	U. Stoker
Crompton & Knowles Loom Works	Worcester, Mass.	199	387	1	40,000	4,750	456	..	.....	..	.....	2,500	P. C.
Star Beverage Co.	Minster, Ohio	199	Sat.	1	200%	2,090	....	..	.....	..	.....	.....	U. Stoker
U. S. Navy	Brooklyn, N. Y.	175	498	3	62,000	8,070	....	..	.....	..	.....	2,704	U. Stoker
Broadmoor Hotel Inc.	Colo. Springs, Colo.	160	465	1	25,000	4,160	....	..	.....	..	.....	2,351	Nat. Gas
Baltimore Pure Rye Distilling Co.	Dundalk, Md.	150	366	3	45,000	2,500 2,500 5,270	....	..	.....	..	.....	720 720 1,390	Oil
Carey Salt Co.	Hutchinson, Kan.	150	500	4	128,000	21,400	....	..	.....	..	.....	.....	Gas & Oil
Century Distilling Co.	Peoria, Ill.	150	466	4	200%	5,000	....	..	.....	..	.....	.....	Chain Grate
Indiana Condensed Milk Co.	Sheridan, Ind.	125	Sat.	1	.....	4,990	....	..	.....	..	.....	.....	Stoker
Merck & Co., Inc.	Rahway, N. J.	125	353	1	82,500	8,280	....	..	.....	..	.....	1,500	U. Stoker
Southern Chemical Cotton Co.	Chattanooga, Tenn.	125	Sat.	2	4,050	.....	....	..	.....	..	.....	.....	U. Stoker
Delaware Rayon Co.	New Castle, Del.	....	...	..	.....	.....	....	..	.....	..	.....	.....	.....
MUNICIPAL PLANTS													
Wyandotte	Mich.	450	700	2	250%	6,200	....	..	.....	2	.....	.....	U. Stoker
Water & Light Dept.	Hastings	448	700	1	55,000	6,160	992	1	1,061	1	5,200	.....	P. C.
Water Works	Springfield	400	700	1	110,000	.....	.....	..	.....	..	.....	.....	.....
Dept. of Water Supply	Detroit, Mich.	380	710	2	90,000	10,388	510	2	2,430	2	9,980	4,125	U. Stoker
Shelby	Ohio	250	600	1	45,000	5,040	....	..	.....	..	.....	.....	U. Stoker
Chanute	Kan.	225	600	3	.....	5,300	....	..	.....	..	.....	.....	Oil
Pumping Station	Miami, Fla.	115	Sat.	3	33,000	7,750	....	..	.....	..	.....	11,868	.....
Hinsdale	Ill.	....	....	..	.....	.....	....	..	.....	..	.....	.....	.....
University of Ark.	Fayetteville, Ark.	200	Sat.	1	200%	4,200	....	..	.....	..	.....	.....	Gas
Rikers Island Prison	New York, N. Y.	200	...	4	38,000	5,100	....	..	.....	..	.....	.....	U. Stoker

C.T.—Condensing Turbine, T.C.T.—Tandem Compound Turbine, V.C.T.—Vertical Compound Turbine, B.P.T.—Back Press Turbine, B.B.P.T.—Bleeder

OR UNDER CONSTRUCTION DURING 1934

Fans — Forced: Number	Fans — Forced: Capacity, c.f.m.	Fans — Induced: Number	Fans — Induced: Capacity, c.f.m.	Boiler Feed Pump: Number	Boiler Feed Pump: Capacity, g.p.m.	Main Generating Units: Number	Main Generating Units: Type	Main Generating Units: Capacity, Kw.	Bleed Points: Number	Bleed Points: Pressure, Lb. Per Sq. In.	Condenser Surface, Sq. Ft.	Circulating Pump: Number	Circulating Pump: Capacity, g.p.m.	Remarks
2	112,500	2	185,000	..	....	1	T. C. T.	80,000	5	...	52,500	2	55,000	New Plant To Go in Operation 1935.
4	101,000	4	181,000	..	650	3	C. T.	30,000	4	...	27,000	..	36,000	1 Unit in Operation 1934.
2	102,500	2	190,000	..	....	1	T. C. T.	165,000	4	...	113,000	..	.....	Addition-Operation 1935.
..	.....	..	.....	..	....	..	.....	.....	..	...	.....	..	.....	.....
6	.....	6	.....	2	1,500	2	C. T.	1,000	..	...	.....	..	.....	.....
..	.....	..	.....	..	....	1	C. T.	3,000	..	...	.....	..	.....	.....
..	.....	..	.....	..	....	1	C. T.	7,500	..	...	.....	..	.....	Operation Jan. 1935.
..	.....	..	.....	..	....	1	B. P. T.	10,000	..	...	.....	..	.....	Exhaust Press. 250 Lb. Under Construction.
4	79,000	2	282,000	2	2,400	1	V. C. T.	110,000	4	...	.....	2	58,700	Under Construction.
2	78,000	1	180,000	2	....	1	B. B. P. T.	7,500	1	200	.....	..	.....	Exhaust Press. 100 Lb. In Operation.
3	37,000	3	74,000	3	562	2	B. P. T.	3,375	..	...	.....	..	.....	Exhaust Press. 150 Lb.
1	40,400	1	102,500	..	....	1	B. B. P. T.	5,500	1	235	.....	..	.....	Exhaust Press. 150 Lb.
..	.....	..	.....	3	700	..	.....	.....	..	...	.....	..	.....	.....
2	98,500	2	144,000	..	....	1	B. P. T	5,000	..	...	.....	..	.....	Exhaust Press. 195 Lb. In Operation.
..	.....	..	.....	..	....	1	B. P. T.	3,000	..	...	.....	..	.....	Exhaust Press. 130 Lb. In Operation.
2	98,500	2	144,000	..	....	1	B. P. T.	7,500	..	...	.....	..	.....	Exhaust Press. 35 Lb. In Operation.
2	56,000	..	.....	2	850	1	B. P. T.	1,500	..	...	.....	..	.....	Under Construction Will Be Completed Jan. 1. 1935
1	23,200	1	52,500	1	200	1	B.P.T.	1500	..	...	.....	..	.....	Exhaust Press. 150 Lb. In Operation.
1	75,000	1	113,000	2	450	1	B. B. P. T.	5,000	2	...	2,400	1	3,000	Operation Jan. 1935.
2	59,000	2	82,500	..	....	1	B. P. T.	2,000	..	...	.....	..	.....	Exhaust Press. 25 Lb. In Operation.
2	23,600	2	41,300	1	180	2	B. B. P. T.	2,500	1	90	900	1	750	.....
..	.....	..	.....	2	500 365	2	C. T.	6,000 7,500	..	...	.....	..	.....	In Operation.
1	10,500	1	34,000	2	90	1	B. B. P. T.	1,437	1	...	1,610	1	.....	Exhaust Press. 10 Lb. In Operation.
..	.....	..	.....	..	....	..	.....	.....	..	...	.....	..	.....	.....
..	.....	1	45,000	..	....	..	.....	.....	..	...	.....	..	.....	.....
3	35,000	3	61,000	1 1 1	320 240 120	2 2	C. T.	5,000 1,875	3 2	... ...	8,000 9,500 2,500	1 1 2	10,000 11,900 3,000	Under Construction.
1	15,000	1	25,000	2	85	1	B. P. T.	500	..	...	.....	..	.....	Exhaust Press. 100 Lb. In Operation.
1	36,000	..	.....	2	....	1	C. T.	3,000	3	...	3,000	1	2,400	.....
1	49,000	1	70,400	4	310	3	B. B. P. T.	2,800 2,250 1,700	..	155 85	.....	..	.....	Exhaust Press. 25 Lb. & 100 Lb. In Operation.
1	52,000	1	88,520	2	460	1	B. B. P. T.	7,500	1	...	.....	..	.....	In Operation Exhaust 3 Lb.
2	40,000	..	.....	2	150	1 1	B. C. T.	5,000 1,000	2	...	6,400 1,295	1 1	7,050 1,560	In Operation.
1	25,000	1	52,000	..	....	1	B. C. T.	3,000	..	...	.....	..	.....	.....
..	.....	..	.....	..	....	1	B. C. T.	4,000	1	25	.....	..	.....	.....
3	.....	..	.....	2	....	2	B. C. T.	1,000	1	60	.....	..	.....	.....
1	47,500	1	80,000	1	700	..	.....	.....	..	...	.....	..	.....	.....
..	.....	..	.....	..	....	..	.....	.....	..	...	.....	..	.....	Operation, Jan. 1935.
3	.....	..	.....	3	....	..	.....	.....	..	...	.....	..	.....	In Operation.
2	18,600	..	.....	2	900	4	3-C. T. 1-B. P. T.	3,000	1	13	1,995	..	.....	In Operation.
2	.....	..	.....	2	40	..	.....	.....	..	...	.....	..	.....	Operation, Jan. 1935.
2	.....	..	.....	2	....	..	.....	.....	..	...	.....	..	.....	In Operation.
2	41,000	2	83,000	2	600	2	B. B. P. T.	1,500	1	75	.....	..	.....	In Operation.
..	.....	..	.....	..	....	..	.....	.....	..	...	.....	..	.....	.....
1	.....	1	.....	..	....	..	.....	.....	..	...	.....	..	.....	In Operation.
1	12,500	..	.....	..	....	..	.....	.....	..	...	.....	..	.....	.....
1	.....	..	.....	1	....	1 1	T. E.	75 110	..	...	.....	..	.....	.....
6	16,500	..	.....	..	....	1	C. T.	2,500	1	...	3,800	..	.....	Replaces Old Equipment Under Construction.
1	6,300	..	.....	2	200	2	C. T.	200	..	...	.....	2	100	In Operation.
1	.....	..	.....	2	1,500	..	.....	.....	..	...	.....	..	.....	In Operation.
1	.....	..	.....	2	320	1 1	B. P. T. C. T.	800 1,250	..	...	.....	1	100	.....
4	15,000	..	.....	2	250	1 1	C. T. B. P. T.	780 625	..	...	800	..	.....	.....
..	.....	..	.....	1	....	2	B. P. T.	100	..	...	.....	..	.....	In Operation.
1	6,000	..	.....	1	140	2	E.	400	..	...	.....	..	.....	In Operation.
1	.....	..	.....	2	8x5x12	..	.....	.....	..	...	.....	..	.....	.....
..	.....	..	.....	..	.....	1	B. P. T.	600	..	...	.....	..	.....	In Operation.
2	22,500	2	44,500	2	125	1	C. T.	2,500	..	...	.....	..	380	In Operation.
1	21,500	1	27,000	2	150	..	.....	.....	..	...	.....	..	.....	.....
..	.....	..	.....	..	....	1	T.	.....	..	...	.....	..	.....	.....
1	45,000	1	75,000	..	....	2	C. T.	5,000	..	...	.....	..	.....	In Operation.
..	.....	..	.....	..	....	1	B. C. T.	1,500	1	5	1,750	1	2,700	In Operation.
..	.....	..	.....	2	....	3	.....	5,000	2	...	10,850	5	2,170	.....
..	.....	..	.....	3	6x4x6	4	C. T.	.....	..	...	2,100	..	.....	Turbine Drives Pump.
..	.....	..	.....	..	....	1	.....	2000	..	...	.....	..	.....	.....
..	.....	..	.....	1	....	..	.....	.....	..	...	.....	..	.....	.....
..	.....	..	.....	..	....	3	E.	500	..	...	.....	..	.....	In Operation.

Black-Press. Turbine, B.C.T.—Bleeder Condensing Turbine, E.—Engine.

STEAM EQUIPMENT

Plants install 1,300-1,400-lb. boilers: Firestone for 300,000 lb. per hr., Ford for 1,000,000 lb. (expected) at 900 deg., Port Washington for 700,000 lb. at 825 deg. Integral-furnace boilers give 82-84 per cent efficiency without economizer or air heaters. Richmond installs largest condenser

AS ALL high-pressure boilers under construction during the past year were of the bent-tube type, one might conclude there is a trend toward the type for high pressures. The relatively few high-pressure units under construction, however, makes any such conclusion as to trend dangerous.

Of the 1,200-1,400-lb. boilers ordered during 1934, that for Firestone is the most interesting because of its new features, not all of which can be described at the present time. Its 54 in. dia. by 23 ft. long and 4-in. thick drums have been fusion welded, making this the largest welded drum so far installed. The unit is designed for a maximum output of 300,000 lb. per hr. at 1,400 lb. pressure and 760 deg. F. It contains 11,793 sq.ft. of heating surface in the boiler and 7,584 sq.ft. of surface in the water walls which entirely surround the 14,500-cu.ft. furnace.

The water walls are unique in that they are hung from the top headers which are supported by I-beams wholly independent of the boiler. The whole weight of the walls and slag bottom is thus carried by the tubes. This arrangement allows the entire water wall to expand downward freely as the wall heats when the boiler is fired up.

The boiler casing is arranged so that it encloses the air preheater, economizer, plenum chamber and all piping for the water walls. The only piping outside the casing is used for soot blowing. This makes for a clean-looking job. Special arrangements have also been made for improving circulation in the water walls.

The new 1,350-lb. pressure boiler for Ford Motor Co. is very similar to the previous Ford units except that it has somewhat greater capacity. The two units that went into operation in 1931 each had a maximum capacity of 700,000 lb. per hr., whereas the new unit has a guaranteed output of 800,000 lb. per hr. and the manufacturers hope for a maximum output of a million pounds. Even though some predicted to the contrary, large boilers are still being built. Large units will probably continue to be built because of the continued building of plants, both industrial and central station, wherein each turbine is served by a single boiler. This has come about because of improved reliability of boilers, availability factors as high as 97 per cent having been reported during the past year.

Superheaters for the Ford boiler are designed to raise the steam temperature to 900 deg. Alloy steel has been used in their construction. For high temperatures, superheater tubes of chrome-nickel and chrome-molybdenum alloys are being used.

Port Washington is an example of a plant built on the unit principle; one 690,000-lb. per hr. boiler is being installed to serve an 80,000-kw. turbine. The unit is designed to deliver steam at 1,320 lb. pressure and 825 deg. It contains 44,100 sq.ft. of boiler heating surface and 7,710 sq.ft. of surface in the water walls. This project was initiated in 1931, consequently the boiler design does not reflect 1934 even though the plant will not be placed in operation until this year.

HIGHER steam temperatures have required the development of means for closely controlling the final temperature. The two-stage superheater in the Buzzard Point boilers is reported as giving satisfactory performance. The new stoker fired boilers for 600-lb. pressure and 825 deg. temperature installed at the Connors Creek plant of the Detroit Edison Co. have compensated superheaters similar to those developed at Trenton Channel, but with some improvements. Each of the boiler units consists of two three-drum boilers, the rear top drums being raised above the water level in the front drums to make them act as dry steam drums. They are designed for a maximum capacity of 330,000 lb. per hr. Each center top drum and the two bottom drums are constructed of two plates of different thickness welded together. More superheating surface is located in one side of the boiler than in the other and gas flow is proportioned by dampers giving constant outlet steam temperature over a wide range of steam output.

New spacers have been developed for intertube superheaters. The spacers are welded to the superheater tubes, thus providing the necessary cooling effect to protect them from overheating.

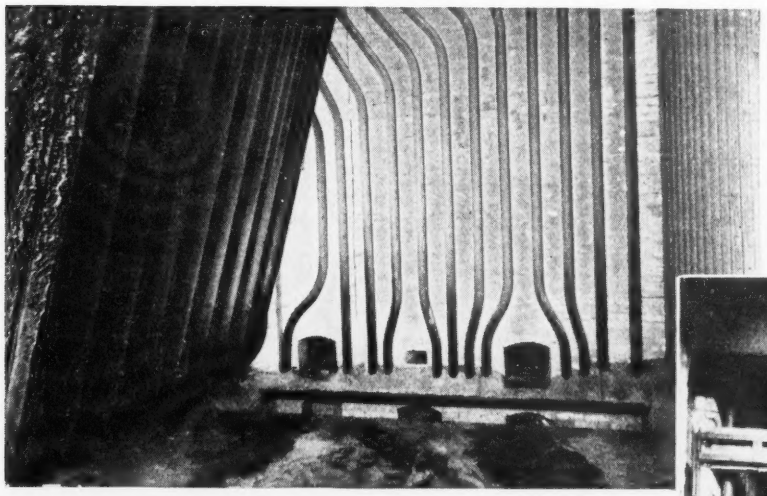
The two new boilers serving the 165,000-kw. additions to Richmond station of the Philadelphia Electric Co. reflect the design of the Buzzard Point boilers. They are each of 600,000 lb. per hr. and will supply enough steam at 400 lb. and 850 deg. to generate 135,000 kw., sufficient for the present needs of the Philadelphia system. The units each contain 36,200 sq.ft. of boiler heating surface and 4,648 sq.ft. of surface in the water wall. The slag bottom, pulverized-coal-fired, furnace has a volume of 26,900 cu.ft. As in the Buzzard Point boilers, two rows of refractory-covered tubes are placed at the throat of the furnace and act as slag screens. The distance between the slag screens and the main boiler tubes is considerably greater than in the Buzzard Point units, thus providing a better opportunity for combustion to be completed before the gases reach the cooler surface.

The cross-drum boiler is of the high-head, two-stage type. The 72-in. dia. drum is about 28 ft. above the first row of boiler tubes. Seven rows of tubes form the first stage and immediately above is a continuous-tube self-draining superheater. Behind the superheater in the path of gas-travel, and located in the other half of the recess above the first-stage boiler section, is the second, or forced-feed stage of the boiler, which is of the continuous tube type. An air preheater having 27,100 sq.ft. of surface is behind the forced-feed section.

fired from the side, and combustion gases flow to the opposite side, where they pass between the boiler tubes which are spaced widely to form a slag screen. The superheater is behind the first pass of seven boiler tubes. After the superheater, the gas turns and passes back through the remaining tubes in two passes. Boiler tubes are approximately vertical, whereas gas flow is horizontal except in the last pass, as it flows up and out through the boiler damper. The first pass is slightly less than half the width of the boiler and takes in the full length of the tubes. The front row of tubes nearest the burner is baffled with a stud-type refractory construction. Ashes are removed periodically by raking them into the pit shown at the far wall.

Tests on this boiler have shown a very flat and high efficiency curve. At about 100 per cent rating an efficiency of 84.6 per cent is reported, while at 274 per cent rating it drops only to about 82 per cent. These figures are for boiler alone—no economizer or air preheater being installed.

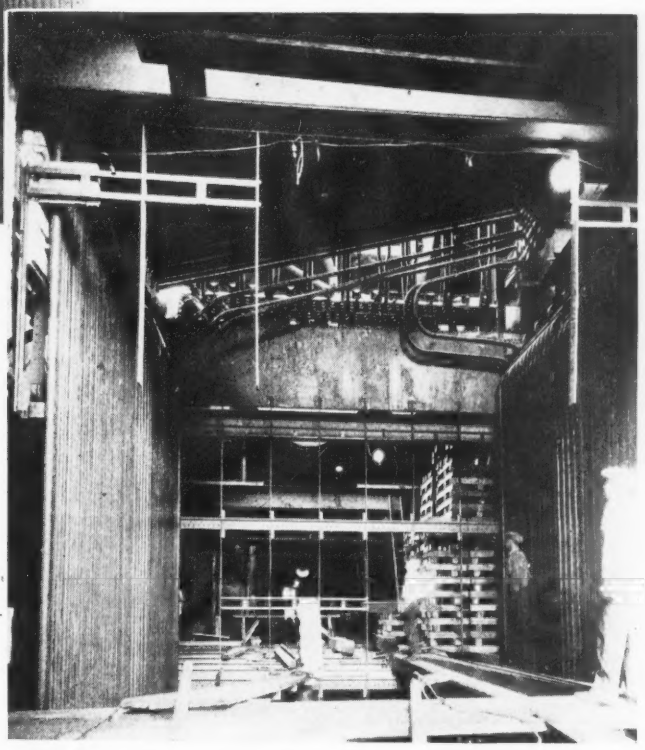
Very few changes have been made during the past year on fuel-burning equipment. Census figures seem to indicate that stoker firing is more popular than pulverized coal-firing. From Jan. to September, 1934, inclusive 1,404 stokers were sold for use under 2,774,000 sq.ft. of boiler surface as against 131 unit pulverizers for use in firing 377,900 sq.ft. of surface.



Integral furnace boiler. Ash pit is shown at rear and gas passage through tubes at left

Three installations are in operation of a boiler of radically different arrangement as to gas flow. It is known as the integral-furnace boiler and is designed particularly for pulverized-coal, gas- or oil-fired units of relatively low capacity where compactness is a requirement. Such a boiler, of 40,000 lb. per hr. capacity, was installed in the Clinton Cotton Mills described in the September, 1934, number of *Power*. It has a single mud drum and steam drum and, as shown above, the furnace is completely water-cooled, including bottom and roof. The boiler is

Boiler for Firestone Tire & Rubber Co. has a maximum capacity of 300,000 lb. per hr. of 1,390 lb. pressure steam at 840 deg. Boiler drum is largest fusion welded drum



The price of oil increased considerably and fewer new oil burning installations were made. Nevertheless new installations continue to use burners capable of burning pulverized coal, oil or gas, so that the most economical fuel can be burned as market conditions change.

Changes have been made in the design of the Coxe stoker which permit it to be used in furnaces up to 24 ft. wide, the older stoker being limited to 11-ft. widths. The new design employs two or more carrier bars placed end to end instead of a single bar across the stoker, as in the older design. The Green chain-grate stoker has also been modified. Instead of a cast-iron frame supported on wheels, the new stoker has a stationary structure fixed into the setting, thus providing for fixed attachment of controls.

A new stoker for small boilers up to 1,500 sq.ft. of heating surface has been developed. A screw conveyor advances the coal from the hopper to the entrance of the retort, and a reciprocating pusher continues feeding and agitating the fuel bed. The unit is built for either center or side retort arrangement.

IN larger stokers, improvements have been made in many details of drive and control of feeding mechanisms. For high ratings, zoned air control has been found of great value not only in maintaining efficient combustion but also in increasing the coal-burning rate. These stokers for the new boilers at Connors Creek have been equipped with automatic zoned air control, and on all of the stokers in the final addition to Hudson Ave. a manually operated zoned air control system has been provided which increased the maximum coal-burning rate from 55 to 75 lb. of coal per sq.ft. per hr.

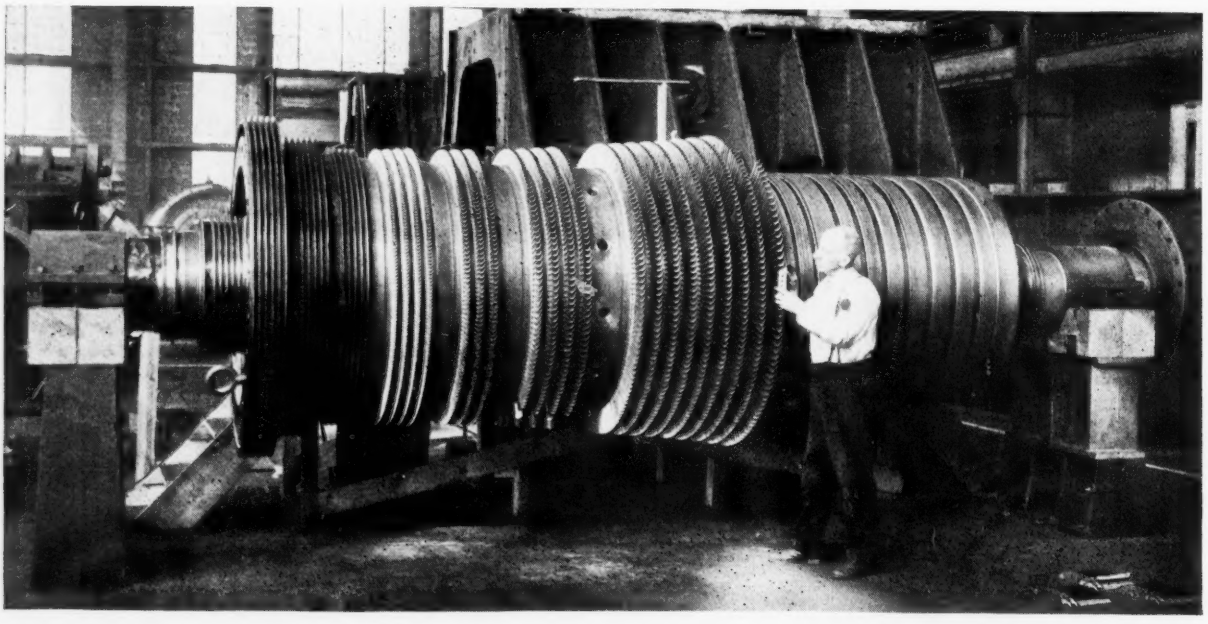
Few changes have been made in pulverizing equipment. One manufacturer has improved the material used in the grinding rings so that both rings now give equal wear. Another manufacturer is developing a new unit pulverizer. Interlocking control has been developed for pulverized coal equipment so that fans and mills can not be started except in proper sequence.

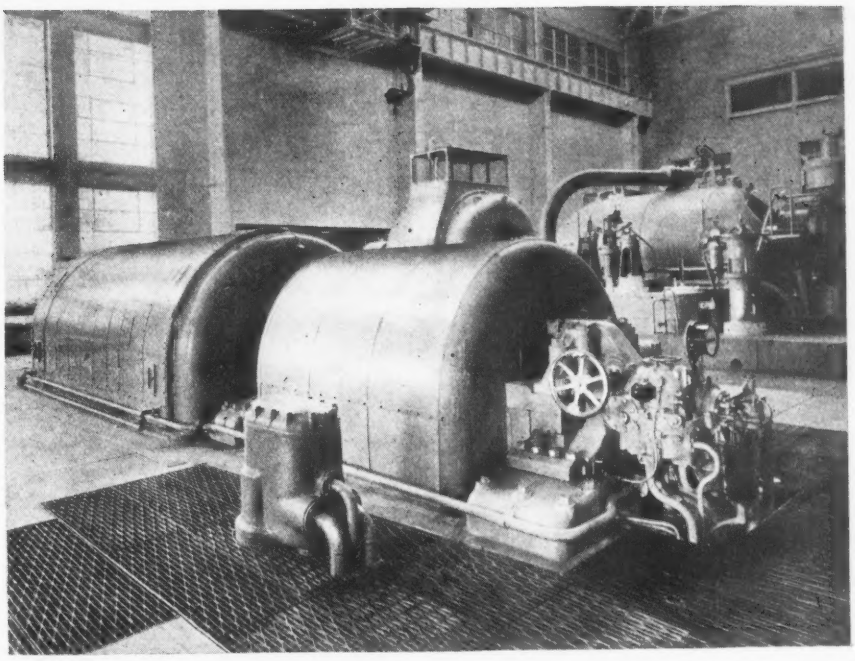
Steam Prime Movers

Ever since the 1,000-deg., 10,000-kw. turbine experimental installation of Detroit Edison Co., great impetus was given to increases in initial steam temperatures. Since then steady progress has been made. With the order by the Ford Motor Co. for another 110,000-kw., vertical-compound turbine, the upper temperature limit for commercial units was raised another 50 deg. to 900 deg. F. Because of this high initial temperature, this turbine, receiving steam at 1,200 lb. pressure, will operate condensing without reheating the steam, thus avoiding the expense of reheaters. The new unit is in general similar to the previous unit of the same type and capacity which was designed for 725 deg. Both high- and low-pressure turbines operate at 1,800 r.p.m. The high-pressure turbine and generator are mounted on top of the low-pressure turbine and generator, thus saving floor space. Surface air coolers are built integral with the common generator housing. A 15,000-kw., non-condensing unit to operate with steam at the same initial conditions will exhaust at 250 lb. to process.

The 165,000-kw. turbine for Richmond, the largest single-shaft turbine that has been built, is nearly ready for shipment. The high-pressure element is of the single-flow, straight reactive type. The rotor, shown below, is made up of a chrome-molybdenum steel forging at the high-pressure end and forged carbon steel at the low-pressure end. Ten chrome-molybdenum disks are shrunk on a carbon-steel shaft to form the low-pressure rotor, which is of double-flow type. The last three low-pressure stationary rows

High-pressure rotor for 166,000 kw. Richmond turbine.





New 18,000-kw., 3600-r.p.m. turbine which replaces the original unit installed at the Burlington station of the Public Service Gas and Electric Co. It is supplied with steam at 650 lb. pressure and 850 deg. F.

consist of groups of stainless-steel blades cast into cast-iron bases and shrouds.

Several outstanding 3,600-r.p.m. turbines have been built during the past year, among them a 10,000-kw. unit for Firestone Tire & Rubber Co. to operate at 1,200 lb. pressure and 750 deg., a 10,000-kw. turbine for Diamond Alkali Co. to operate at 725 lb. pressure and 800 deg. F., and a 7,500-kw. unit operating at 725 lb. pressure and 725 deg. for Goodyear Tire & Rubber Co.

One of the 30,000-kw. turbines in the modernized section of Connors Creek plant went into operation during November, 1934. In this unit, operating on steam at 600 lb. pressure and 825 deg., parts of two older units were used. The generator came from the 30,000-kw. unit that was No. 8 in Delray No. 2. Certain parts, such as exhaust hoods and bearings of the 20,000-kw. turbine, which the new unit replaces, were used in constructing the new high-pressure turbine. This is the first of three units now under construction.

Rayon companies installed a number of turbine-generators to operate at 180 cycles. Two 2,350-kw., 3,600-r.p.m. units are being built to operate at this frequency.

Continued research on turbine blading has brought about changes yielding improved efficiencies, particularly in the last rows. New rotating blades for last rows are of the impulse type at the inner diameter, reaction type at the mean diameter and have an airfoil section at the outer diameter. This new type of blade demands stationary blade structures of greater dimensions and more complicated shape than previously used. As a result, the stationary blades are cast without roots, ground to required finish, and then cast into a cast-iron base in groups of 6 to 10.

Balanced-type control valves have been generally used in the past. Lately there has been a tendency to use unbalanced single-seated valves of the plug type. Use of a diffuser has permitted a reduction in size of control valve without any corresponding increase in pressure drop. In smaller units, valves of this type are lifted by a single crossbar operated by a single cylinder. Improvements of control have been made so that when necessary speed can be maintained within 0.1 per cent.

Research into the character of steam flow between the exhaust annulus and the condenser tubes has been in progress and has reduced the pressure drop in the exhaust hood. Effect of stays and the usefulness of deflectors has been determined.

Welding is now widely used in construction of turbine nozzles and bases, pipe fabrication, etc. It is not used, except where weight is important, for building up turbine cylinders.

DURING the past year there has been installed the largest amount of condenser surface enclosed in a single shell. This condenser will serve the 165,000-kw. unit at Richmond St. station and has 113,000 sq.ft. of condensing surface made up of 17,630 tubes $\frac{7}{8}$ in. in dia. and 28 ft. long. It is designed to condense 1,600,000 lb. of steam per hr. and will require 152,000 g.p.m. of circulating water.

Very little operating data have been made available from the two recent mercury-vapor installations. The unit at the Kearny plant of Public Service Electric & Gas Co. has been in service 57 per cent of the time and generated a total of 82,245,000 kw.-hr. during 10,995 hr. elapsed time, a capacity factor of 37.4 per cent.

DIESEL ENGINES

By E. J. Tangerman

Associate Editor

Diesel engines catch the popular fancy due to achievements in trains and railcars. Development most rapid of any prime mover, with installations of about 750,000 hp. during year.

"ALMOST spectacular" development, to quote Dr. C. F. Hirshfeld, characterized the diesel industry during 1934. While bad economic conditions have meant fewer power projects generally, the diesel industry has been a decided exception.

The reasons are several. Successful runs with the new high-speed trains captured public fancy, putting the word "diesel" on every tongue. Again, the increased agitation for municipal plants and private generation, for diesel-powered naval auxiliaries, for dieselized trucks and buses, all have contributed. Backing them up has been increased rotative speed (meaning lighter weight or more power), increasing use of supercharging, refinements in design and materials (meaning less maintenance and better performance) and the almost universal adoption of solid injection as a result of increasing use of distillate fuels and greater simplicity of installation. Topping these off has been announcement of a new record high efficiency, 41 per cent, for a pair of 2-cycle engines. This means total heat utilization of 91 per cent! During the year, about three-quarters of a million horsepower of diesels were installed, 125,000 of it being for marine use, around 300,000 for trucks, buses, construction equipment, trains, etc., the rest for stationary installations, mostly in fairly small plants. Most of those installed early last year were listed in the June Table.

Greatest fields in development of the diesel during the past year were in transportation—train, railcar, truck, bus—and in the small or comparatively small stationary plants. In the first case the diesel's great advantage is its economy, in the second, its simplicity coupled with its higher thermal efficiency. For the latter service, several types of automatic plants have been developed, and utility companies are beginning to speak of local diesel plants for small loads well away from the large steam plants, where transmission line cost is prohibitive and interruptions due to single highline service are frequent. Further, Federal grants and loans have initiated new or enlarged diesel plants for municipal light and power.

Development of small diesel power units is little short of spectacular, both in this country and abroad. One company supplying engines for trucks had only 100 installations in January, 1934; by November they had made a thousand! London, England, in 1931 had 12 diesel buses, all England only 25. Today the latter figure has become 5,500. It appears probable that gasoline engines are doomed in sizes above 4-in. cylinder bore, due both to evasion of fuel taxes and to the 50% reduction in weight of fuel burned.

One American builder of diesel power units began late in 1931 by building 1,056 hp. Last year the figure was 237,314 hp.—some 3,000 units of the company's total of 5,000. Today that company builds five sizes of diesel power units.

Another truck engine builder now has one fleet of over 75 engines, another close to 30, another over 35, all brought about because truck operations must cut costs.

An associated field—construction equipment, including shovels, cranes, compressors, crushers, hoists, locomotives, and tractors has likewise been going steadily dieselward. More than 30 manufacturers of such equipment now use diesels.

ALSO in marine work, the diesel is coming forward. Fishing boats, pleasure craft, tugs, ferries, etc., used 125,000 hp. of diesels last year. But there is still reticence on the part of builders of large ships in this country to use diesels. Of course, there has been but little building here, but of that (1.7% of the world total) only 2% (.034% of the world total) is diesel driven. The world picture is very different. World motorship tonnage rose from 1,540,463 in 1922 to 10,604,526 in 1934, an increase of 590.6%, while steamship tonnage has dropped from 59,802,489 to 53,753,266 in the same years, a decline of 10.1%. Of tankers under construction, 87.8% will be diesels.

One step in the right direction is the recently announced intention of the Navy to replace all small gasoline-driven craft by diesel-driven units in the immediate future. For details, see news pages. There are those who expect an extensive naval program in 1935 on submarines and "pocket battleships," all with compression-ignition engines.

Aluminum and welded steel frames, developed primarily for marine use, are also finding extensive use on railcars and will eventually also form the basis for truck and bus engines, aviation engines, in fact in any units where compactness and light weight per engine horsepower is a requirement. A number of welded-steel frame engines have already been installed in stationary plants. One company has just completed several aluminum castings for locomotive engines, comprising engine frame and water jacketing all in one unit. Weight is reduced from 3,000 lb. for cast iron to 1,640 lb. for aluminum, utilizing a special heat-treated alloy designed for high-stress service. One company manufacturing steel-frame diesels has sold over 30 units for marine work during the past year, and now has in its shops 24 engines for the new high-speed trains and 12 for the Navy. Another company brought out early in the year a crankless diesel based on the Michell patents.

While not strictly a diesel, the low-compression engine using the Hesselman system is advancing steadily. Several installations of this type have been made for ice companies in the South to replace electric motors for compressor drives; one has gone in for lighting, heating and air-conditioning a Long Island home; many have gone into tugboats, barges, cruisers and other marine craft.

Advances in diesel plant design and in dependability of auxiliaries are bringing it steadily to the fore as a source of industrial plant power. Once engineers thought that a diesel plant had to have two expensive slow-speed engines, one for standby. Today, this is taken care of by one slow-speed engine and one inexpensive high-speed unit for emergency service. Auxiliaries are becoming more and more foolproof.

Piston speeds are being stepped up continuously, with commercial engines being installed for 1,100 and 1,200 ft. per min. for continuous operation. Rotative speeds are also being pushed up, even engines of 6,000 hp. and over having speeds of 225 to 250 r.p.m. and above. The trend toward higher speeds is also marked in smaller engines, units of 600-800 r.p.m. being generally available for powers up to 1,000 b.hp.

The trend towards higher speeds and the demand for higher specific horsepowers has urged most builders, especially those in Europe, to reach the highest limits of heat liberation per cubic inch of piston displacement consistent with satisfactory liner and ring wear, and with satisfactory life of piston crowns and cylinder heads. This naturally means supercharging—whether it is called that or not. Since 2-cycle engines normally supply combustion air by blower, it has been simple enough for several builders to increase the pressure and thus obtain a supercharging effect. It is interesting to note that their builders claim high m.e.p.'s without even mentioning supercharging.

Naturally, designers of 4-cycle units are beginning to avail themselves of pressure charging, particularly for those units in which the regular atmospheric admission meant pressures considerably below atmospheric at the beginning of the compression stroke. By means of this so-called supercharging, m.e.p.'s have been successfully boosted as much as 25 to 40%.

A few refinements are still needed in small diesels especially in the combustion process. At mid-year, one Continental builder announced 3-dimensional turbulence by changed combustion chamber design, obtaining m.e.p.'s as high as 115 lb. sq.in. with clear combustion. Further development along this line will give diesels which will develop higher specific outputs than will corresponding spark-ignition engines.

The old rivalry between 2-cycle and 4-cycle engines continues unabated, although the 2-cycle unit shows decided advantages in cylinder bores above 25 in. and the 4-cycle engine showing best performance in bores below 8 in.

Diesels several years ago reached thermal efficiencies of 35-36 per cent, higher than those of any other prime mover, so high indeed that little hope remained for decided improvement. But in 1934 one of the leading European builders showed acceptance tests of two marine engines developing 5,500 hp. each in which fuel consumption reached the extremely low ratio of 0.329 lb. per b.hp. of 18,000-B.t.u. fuel, corresponding to about 41 per cent thermal efficiency, an all-time record for commercial heat engines of any sort.

THE diesel fuel situation was much improved during 1934. The A. S. T. M. issued a tentative specification for diesel fuels, with faults enough, to be sure, but still a step in the right direction. General opinion is that fuels can be worked out suitable both for diesels and for the rapidly growing oil-burner industry, thus simplifying supply and reducing storage tankage, etc. A long list of oil companies are providing fuels that meet diesel-builders' specifications, and co-operative work by suppliers and diesel manufacturers is resulting in engines more flexible as to type of fuel burned and more suitable fuels. And why not?—last year, the diesels of one manufacturer alone burned 25,000,000 gal. of fuel! The time is not long until diesel fuel will be almost as easy to get as gasoline.

Developments in the oil industry have tended to utilize more and more of the lighter components of the crude, leaving residuals very undesirable in burning characteristics for diesels. Consequently, diesels have been driven to distilled fuels, which have much better burning properties. Probably in the future very little crude oil or non-distilled oils of good quality will be available for diesel engines. This trend is having a decided effect upon engine design, which has definitely drifted away from air injection to solid injection.

This, then, is the general story of 1934 for the diesel—a year for most builders second only to 1929, to others their best year to date. With present impetus from Government loans and the need for cheaper power in all types of prime-mover fields, the outlook for the diesel is especially bright. 1935 is expected to be the best year so far for the diesel, with construction going to 1,000,000 hp. or above.

ELECTRICITY AND METERS

An increase of five billion kilowatt-hours in public-utility load; generators, transformers, and circuit breakers of record rating; meters to record mechanical performance of steam turbines; and a simplified system of balancing large rotative machines mark progress in 1934

NO RADICAL changes were recorded in power generation equipment last year. However, several record-breaking units are under construction. In the hydro-electric field Boulder-Dam generators are larger in rating, weight and physical dimensions than any units of their class in service. Four units rated 82,500 kva. and one 55,000 kva. form the initial installation. Contracts for the four large machines were divided between General Electric and Westinghouse, the small generator and four large waterwheels going to Allis-Chalmers. Some of the dimensions of the large generators are: over-all height from bottom of frame, nearly 32 ft.; outside diameter of frame housing, 40 ft.; total weight, approximately 1,000 tons; flywheel effect, 11,000,000 WR^2; outside diameter of thrust bearing, 7 ft.; load or thrust bearing, about 900 tons.

Another notable hydro-electric generator is a 35,000-kva., 13,300-volt, 25-cycle, single-phase unit put into operation by Safe Harbor Water Power Corp. This is the largest single-phase generator ever built and will supply power to the Pennsylvania Railroad electrification between Wilmington, Del., and Washington, D. C. When a single-phase generator supplies load a pulsating torque is developed that causes the machines frame to vibrate. To avoid transmitting these vibrations to the foundations, the stator is mounted on springs; other springs cushion the circumferential motion.

The steam-turbine generator now being built by Westinghouse for Richmond station of Philadelphia Electric Co. is one of the largest single units of this type. It is rated 183,333 kva., 0.90 power factor 13,800 volts to operate at 1,800 r.p.m. and will go into operation about the middle of this year. The stator weighs 225 tons and the rotor 125 tons. The latter's core is built up of hollow-disk forgings held together by four 6-in. through bolts according to previous practice, but in this design a 13-in. center bolt is also used. The bolts are stressed sufficiently to hold the disks together with a total pressure of 9,000,000 lb.

Erection of a 25,000-kw. frequency changer at Safe-Harbor plant should be recorded as an outstanding achievement in 1934. This set is designed for railway service and will supply power to the Pennsylvania Railway electrification previously mentioned. The generator is rated 31,250 kva., 0.80 power factor, single-phase, 13,800 volts, 25 cycles and is driven by a 35,000-hp., 3-phase, 60-cycle motor.

Seven high-voltage, water-cooled, power transformers being built for the City of Los Angeles, to Boulder-Dam transmission line will have the largest single-phase rating of any in the United States. They are rated 65,000 kva. continuously, have an overload capacity of 80,000 kva. for two hours and can take care of any emergency overload of short duration. Seven other water-cooled transformers for this line are rated 60 cycles, 55,000 kva., 287,500 to 16,320 volts. These will have a unit weight with oil of 178 tons.

For industrial-plant motor-generator sets the 5,000-hp. unit for Ford Motor Company's River Rouge plant is outstanding. The motor is coupled to two 3,000-kw. 750-volt direct-current generators and a 50-ton flywheel. This unit supplies power to a 7,000-hp. motor driving a 44-in. reversing blooming mill. Six 3,500-hp. motors are being built to drive the finishing stands of a 79-in. hot-strip mill being installed by Youngstown Sheet & Tube Co. Power to these motors will be supplied by two 6,000-kw. motor-generator sets. This will be the most heavily powered strip mill in operation, having 37,500 hp. total motor capacity installed.

Power limitations of interconnected and transmission systems have emphasized the need for higher-speed interruption of fault currents. With plain-break type of contacts it was impracticable to approach these requirements. Steel-tank oil breakers of conventional design equipped with interrupters can now be built to open a high-voltage circuit in three cycles by means of a shielding that distributes the potential proportionally over a number of contacts.

On the 287,500-volt transmission line from Boulder Dam to Los Angeles the circuit breakers are of a new design. They will be used on a higher voltage than any others, have an interrupting rating of 2,500,000

kva. and a rated opening time of three cycles, 0.05 sec. These breakers of a new design, page 52, will require approximately 1,000 gal. of oil each. If built with conventional-tank design, 23,000 gal. of oil would be needed for 287,500 volts.

For several years in lightning investigations voltages in laboratories have been increased until we now have man-made lightning equivalent to 10,000,000 volts. Last year engineers produced a discharge of nearly 250,000 amperes at 150,000 volts, which represented more than 30,000,000 kw. The destructive effect of such power is apparent in the fact that a piece of copper wire 0.1-in. diameter in the circuit is vaporized in the short period of the discharge—eight microseconds. When this power is passed through a flat copper strip, the pinching effect of the magnetic field crumples the strip into a round tube.

Many new metering devices were announced during the year. Telemetering recording instruments were developed for protection and supervision of large turbines from a remote point. These measure and record shaft eccentricity, bearing vibration, shell expansion and interference or rubbing of rotating parts. They give the operator an indication and permanent record of mechanical performance during starting and running periods and with essential operating data. The eccentricity recorder gives accurate knowledge of the shaft eccentricity and makes possible putting the turbine back on the line after a shutdown in a shorter time than formerly.

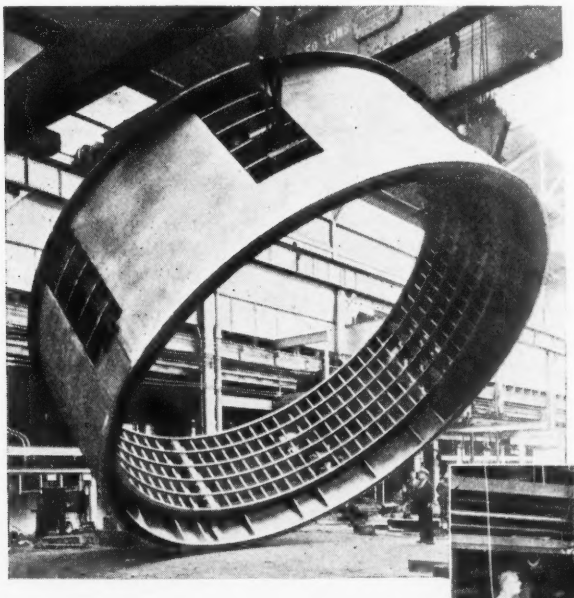
Balancing a large high-speed machine which in the past has been a difficult problem is made simple by a metering system reported on page 718, Mid-December, 1934, *Power*. This equipment consists of two separate generators, a contactor, a meter and a control box. One of the generators is attached to each pedestal of the machine being balanced and the contactor is coupled to its shaft and rotates with it. The generators and contactor are plugged into the control box and meter. Three runs are made with the machine, one without and two with balancing weights on the rotor. From the meter readings the exact weight and its location to balance the machine can be readily determined.

The metering devices just mentioned are an indication of the growing demand for means that will measure minute quantities with a high degree of accuracy. Safe Harbor plant has used a system of applying the oscillograph to recording system frequency, waterwheel-gate movement and governor pilot valve action as a means of analyzing governor performance. This method has revealed information not obtainable otherwise and which made possible improvement in governor design.

A NEON crater lamp has been adopted as a light source for a magnetic oscillograph in order to obtain a record in the shortest possible time after a fault occurred. A photographic film is wrapped around a film drum which rotates continuously. An electronic-tube relay serves to light the lamp upon occurrence of the system fault. The speed of initiation of the lamp is so rapid that the light is up to normal brilliancy by the time the galvanometers are able to respond.

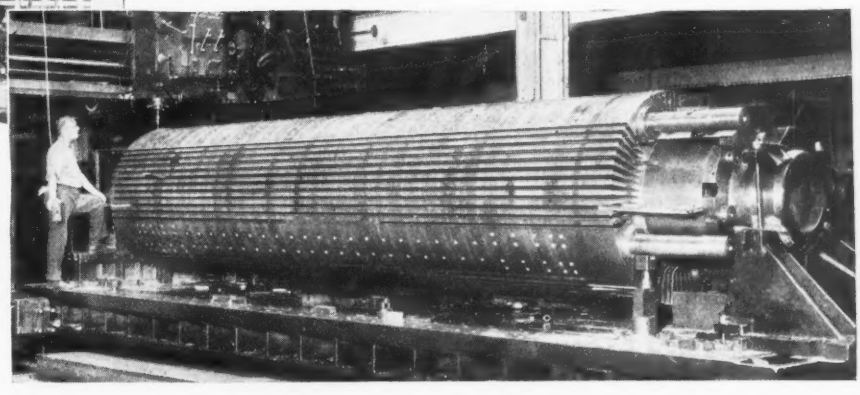
A new frequency recorder has been developed, the pen of which will cross a 10-in. chart in 2 sec. on a frequency change of plus or minus 0.1 cycle.

New telemetering systems have been made available designed to transmit records of pressures, liquid level, temperature, flow or motion over several hundred miles. Several new flowmeters were announced during the year, their designs showing a tendency to electrical types, although new mechanical designs have been made available chiefly to obtain a comparatively low-cost meter. Draft gages of high sensitivity are among new power-plant instruments. One design is sensitive to 0.001 in. of water.



Above—Stator frame for the first 82,500-kva. generator for Boulder Dam. Complete generator will be 40 ft. in diameter, 32 ft. high and weigh about 2,000,000 lb.

Below—Rotor core for 183,333-kva., 1,800-r.p.m. single-shaft generator. Rotor complete with winding will weigh 125 tons.



PUMPS IN 1934

Centrifugal pump efficiencies now so high that 10-year-old units are obsolete. Performance of large pumping units checked by testing models. High-pressure boiler-feed pumps require 2,000-hp. drives. Twenty pumps, each requiring 33,000 hp., proposed for Grand Coulee reservoir on the Columbia River and discharge it into the Grand Coulee against a head of 370 ft. The 20 units will each be rated 520,000,000 g.p.d. and be driven by a 33,000-hp. motor. These pumps are only exceeded in power by some in Europe installed in large pumped-storage hydro-electric plants.

As boiler ratings and pressures increase, feed pumps must be provided to meet these conditions. Two feed pumps for the new boiler being installed in River Rouge plant, Ford Motor Co., are an interesting illustration. These pumps will deliver 1,200,000 lb. of 407 deg. F. water per hour against 1,600 lb. pressure. Each pump is driven by 2,000-hp. motor.

One manufacturer reports development of a 6-stage hydraulically balanced volute centrifugal pump designed for boiler-feed service for pressures up to 1,000 lb. per sq.in. In this pump each impeller is hydraulically balanced by another impeller facing in the opposite direction. The casing is a split volute for each impeller. These volutes are staggered in such a way that radial thrust caused by reaction of a volute on the impeller has been balanced.

Another company reports developing a high-speed, high-efficiency, two-stage, double-suction, boiler-feed pump for direct connection to 3,500-r.p.m. motors and turbines with speeds up to 5,500 r.p.m. This pump is available with constant rising head capacity characteristic in order to assure positive paralleling operation at all loads.

IMPROVEMENTS in efficiency still mark centrifugal pump development. The trend toward higher speeds, compactness and better designs also holds its pace. Power requirements for a modern centrifugal pump are so much less than those for a pump 10 years old and of equal capacity, that the cost saving may pay for the new pump in less than a year. Smaller modern pumps and their motors (a result of increased speed and other factors) cost little more than a major repair to old units of equal rating.

Increased interest in high pump efficiency is shown by tests at California Institute of Technology on models of pumps for Metropolitan Water District of So. Calif. Five pumping stations on the Water District aqueduct will eventually carry one billion gallons of water per day from the Colorado River into the district around Los Angeles. Each of the 45 units (9 per station) will have a capacity of over 130,000,000 g.p.d.

Preliminary study led to tentative conclusions that the pumps probably should not handle more than 350-ft. head in a single stage. For greater heads two single-stage units, each with its motor, would be used rather than a two-stage pump driven by a single motor. The present research is directed towards meeting special conditions along the aqueduct. It is hoped that pump efficiencies of 90 per cent may be secured, which with motor efficiencies around 96.5 would place the over-all efficiency in the high 80's. Some of the pumps will require motors rated at 4,600 kw. for each stage, that is 9,200 kw. on one 440-ft. lift.

These pumps, among the highest powered built in this country, will be dwarfed by those proposed for the Grand Coulee pumping plant. The Grand Coulee pumps will be designed to lift water from the main

ONE of the latest developments in waterworks pumps is the bottom-suction, bottom-discharge type. This construction has the advantage of getting piping under the floor and improving station appearance. An outstanding installation completed within the last year was that for Eastern Hill Station, Cincinnati, O., for 25,000,000 g.p.d. at 470-ft. head. Full-automatic waterworks have been worked out in several ways. One, at Newton, Mass., provides for constant priming of the system so that all pumps are ready for instant start on any electrical automatic control in use. For other installations automatic priming has been applied to individual pumps.

There is a definite trend toward propeller or screw types in preference to conventional centrifugal types when used in conjunction with surface condensers of the single-pass type. This year there were installed two pumps of the propeller type, each having a capacity of 55,000 g.p.m., at Public Service Co. of N. J. plant. Pumps of this type having a capacity of 77,500 g.p.m. each for the Philadelphia Electric Co. are on order.

WATER POWER

Government activity has stimulated hydro-electric power development to a degree not dreamed of two years ago. Projects under construction will cost over $400,000,000

By F. A. Annett

Associate Editor

MIXED trends marked water-power development in the United States during 1934. The large increase in construction was mostly government projects. Because of decreased rainfall hydro-electric plants produced about two billion kilowatt-hours less in 1934 than in 1933. Increased power generation in public-utility plants combined with unusually low rainfall reduced hydro-electric generation to 36.25 per cent of the total, against 40.5 per cent in 1933. As shown by the curves, Fig. 1, installed waterwheel capacity at the end of 1934 exceeded 16,000,000 hp. in the United States and in Canada was 7,547,000 hp.

A sixth 42,500-hp. Kaplan turbine was installed in Safe Harbor plant on the Susquehanna River. This wheel connects to a 37,500-kva., single-phase, 25-cycle generator to supply power for main-line railroad electrification. Areas on this runner's blades likely to pit because of cavitation were made lower than the normal surface and then built up with stainless steel by welding. The blades were then machined all over and polished, a practice used for the first time in this country and marking a distinct construction advance.

The four 115,000-hp. francis-type wheels being installed in Boulder Dam plant are still the highest powered under construction or in operation. Units of 147,000-hp. capacity proposed for Grand Coulee, Columbia River project, will exceed these in power by 30 per cent if the high dam is built. For Joe Wheeler project on the Tennessee River, the 45,000-hp. wheel on order establishes a record for propeller-type turbines with fixed blades. At Safe Harbor, the 42,500-hp. Kaplan turbines since 1930 have held the record for highest powered wheels of that type. They are now exceeded by two rated 60,000 hp. for Bonneville plant on Columbia River Ore. and Wash.

Most large water-power projects in the United States that a few years ago appeared to have little chance of being developed because of economic and other limitations are now actively under construction. An exception is the St. Lawrence River international section. Early last year the U. S. Senate, against recommendations of President Roosevelt, voted not to ratify a St. Lawrence treaty with Canada. Present indications are that a similar treaty will be submitted to Congress early this year for ratification and probably will receive favorable action. The treaty must then be ratified by the Canadian Parliament, where it faces strong opposition, before it becomes effective.

No matter what happens to the St. Lawrence project, there are enough large water-power developments under construction as indicated in the table to keep the industry active for several years. Foremost of these is Boulder Dam on the Colorado River, because of its size and other features. It includes a dam more than twice as high as any constructed and a power house laid out for 1,835,000 hp. in fifteen 115,000-hp. and two 55,000-hp. units. One small and four large machines are now being installed.

At Parker, Ariz., 150 mi. below Boulder, a diversion dam for the Metropolitan Water District of Southern California water system is being constructed. A 110,000-hp. plant is a part of this project. On the All-American irrigation canal, also part of the Boulder Dam development, an 80,000-hp. plant is planned at Pilot Knob, Calif.

On the Columbia River, two power, navigation and irrigation projects are under contract. Bonneville, at tidewater about 140 miles from the river's mouth, comprises a dam and a 720,000-hp. plant. As previously mentioned two 60,000-hp. Kaplan turbines are planned for the initial development.

IN northeast Washington at Grand Coulee, on the Columbia River, the largest hydro-electric plant ever undertaken will be constructed. The plant, proposed for an ultimate installation of eighteen 150,000-hp. units or 2,700,000 hp., will have a greater capacity than the Beauharnois development being built on the St. Lawrence River, planned for forty 53,000-hp. units, of which five have been installed.

As now planned, Grand Coulee will initially comprise a dam 300 ft. high with a foundation completed for a high dam and units rated about 50,000 hp. The contract for constructing the low dam has provisions for a change in plans to construct the high dam. If the present Congress can be induced to provide funds,

Hydro-Electric Projects Completed and Under Construc

Company	Designing Engineers	Project Name	[2]New or Redevelop	River	State	Project Started	[3]Dam Type	Crest Length, Feet	Max. Height, Feet	Initial Operation	Initial Cap., Horsepower
New England States											
City of Norwich, Conn.		Taftville	.....	.....	Conn.	....	.....	.....	...	1935	.....
Bangor Hydro-Electric Co.		Veazie	Redev.	.....	Me.	1933	.....	.....	...	1934	.....
Public Service Co. of N. H.		Lyman Falls	.....	Connecticut	Vt.	1933	.....	.....	....	1934	1,500
Ludlow Mfg. Associates		Red Bridge	.....	.....	Mass.	1933	.....	.....	...	....	.....
Great Northern Paper Co.			New	.....	Me.	....	.....	.....	...	....	.....
Great Northern Paper Co.		North Twin	New	.....	Me.	1933	.....	.....	...	....	.....
Great Northern Paper Co.		North Twin	New	.....	Me.	1933	.....	.....	...	....	.....
Middle Atlantic States											
Safe Harbor Water Pr. Corp.	Penna. Water & Pr. Co.	Safe Harbor	New	Susquehanna	Pa.	1930	G. C. G.	5,000	65	1931	176,200 S.-S. U. 218,700 261,200
Finch Pruyn & Co. Inc.			Redev.	Hudson	N. Y.	1933	.....	.....	....	1934	.....
N. Y. State Gas & Elec. Corp.		Chateaugay	Redev.	.....	N. Y.	....	.....	.....	...	....	.....
East North Central States											
Drake Casket Co.			.....	.....	Mich.	1932	.....	.....	...	1933	.....
Appleton Woolen Mills			New	.....	Wisc.	1932	.....	.....	...	1933	.....
U. S. Government	Corp. of Eng. U. S. Army	Lock & Dam No. 15	New	Mississippi	Ill.	1931	.....	.....	...	1933	375
Maringo River Power Co.	A. E. Appleyard	Maringo	New	Maringo	Wisc.	1931	R. C.	60	7	1933	250
Sanitary District of Chicago	Sanitary District Eng.	Lockport	Redev.	Sanitary Canal	Ill.	1934	.....	.....	...	....	.....
City of Fort Wayne, Ind.			.....	.....	Ind.	1932	.....	.....	...	1933	.....
West North Central States											
Loup River Public Pr. Dist.	Harza Engineering Co.	Monroe	New	Loup	Neb.	1934	P. & G.	800	10	1936	10,000
Loup River Public Pr. Dist.	Harza Engineering Co.	Columbus	New	Loup	Neb.	1934	P. & G.	800	10	1936	54,000
Platte Valley Pub. Pr. & Irr. Dist.	Platte Valley Pub. Pr. & Irr. Dist.	Sutherland	New	N. Platte	Neb.	1934	R. E. F.	18,700	67	1936	35,000
South Atlantic States											
New Kanawha Pr. Co.		Hawks Nest	New	New	W. Va.	1930	.....	.....	...	1935	140,000
City of Radford, Va.			New	.....	Va.	1933	.....	.....	...	1934	.....
Riverside & Dan River Cotton Mills			.....	.....	Va.	1933	.....	.....	...	1934	.....
Virginia Elec. & Pr. Co.		12th St.	.....	.....	Va.	1934	.....	.....	...	....	.....
Kanawha Valley Power Co.	Kanawha Valley Power Co.	London	New	Kanawha	W. Va.	1934	U. S. N.	.....	...	1935	20,850
Kanawha Valley Power Co.	Kanawha Valley Power Co.	Marmet	New	Kanawha	W. Va.	1934	U. S. N.	.....	...	1935	20,850
Thompson-Weinman Co.			.....	.....	Ga.	1933	.....	.....	...	1934	.....
Greenwood County Board of Comm.	D. T. Duncan & Co.	Buzzard's Roost	New	Saluda	S. C.	....	Earth	2,000	85	....	20,000
Cliffside Mills Co.			New	Broad	N. C.	1932	.....	.....	...	1933	.....
Conestee Mills			New	.....	S. C.	1932	.....	.....	...	1933	.....
Washington Mills Co.			New	Middle	N. C.	1932	.....	.....	...	1933	.....
Lilly Mill & Power Co.			New	.....	N. C.	1932	.....	.....	...	1933	.....
East South Atlantic States											
U. S. Tenn. Valley Authority	U. S. Bureau of Reclam.	Norris Dam	New	Clinch	Tenn.	1933	C. G.	1,872	266	....	132,000
U. S. Tenn. Valley Authority	U. S. Bureau of Reclam.	Wheeler Dam	New	Tennessee	Ala.	1933	C. G.	6,335	68	....	45,000
West South Central States											
Central Texas Hydro-Elec. Co.	Fargo Engineering Co.	Hamilton	New	Colorado	Tex.	1931	M. A.	8,377	154	....	30,000
Mountain States											
Public Service Co. of Colo.	U. S. Bureau of Reclam.	Grand Valley	New	Colorado	Colo.	1932	D. R. G.	600	50	1933	4,600
U. S. Bureau of Reclamation	U. S. Bureau of Reclam.	Boulder Dam	New	Colorado	Ariz. & Nev.	1931	G. A.	1,180	730	1936	515,000
Met. Water Dist. of S. Calif.	U. S. Bureau of Reclam.	Parker Dam	.....	Colorado	Ariz. & Cal.	1934	.....	800	340	....	.....
U. S. Bureau of Reclamation	U. S. Bureau of Reclam.	Seminoe	New	.....	Wyo.	1934	.....	.....	...	1938	25,000
Gardner Elec. Lt. & Pr. Co.			New	.....	Mont.	1932	.....	.....	...	1933	.....
Pacific Coast											
Puget Sound Pr. & Light Co.	Stone & Webster Eng. Corp.	Rock Island	New	Columbia	Wash.	1930	C. G.	570	80	1933	84,000
City of Seattle	Lighting & Eng. Dept's.	Diablo	New	Skagit	Wash.	1927	C. A. A.	1,260	389	1935	166,000
U. S. Indian Irrigation Serv.	Barry Dibble	Drop No. 2	New	Yakima	Wash.	1932	.....	.....	...	1933	1,700
Bonneville Pr. Navigation Project	U. S. Engineer Corp.	Bonneville	New	Columbia	Wash. & Ore.	1933	C. G.	900	170	1937 S.-S. U.	125,000 .....
U. S. Bureau of Reclamation	U. S. Bureau of Reclam.	Grand Coulee	New	Columbia	Wash.	1934	C. G.	4,000	500	1938	.....
Sierra Pacific Power Co.	Stone & Webster Eng. Corp.	Farad	Redev.	Truckee	Calif.	1933	Crib.	144	8	1933	.....
Southern Calif. Edison Co.	Southern Calif. Edison Co.	Mill Creek No. 1	Redev.	.....	Calif.	1933	.....	.....	...	1935	.....
Panama Canal Zone											
U. S. Panama Canal	U. S. Bureau of Reclam.	Madden Dam	New	Madden	Panama	1931	C. G.	950	220	1935	22,400
Canada					**Province**						
Shawinigan Water & Pr. Co.	Power Engineering Co.	Rapide Blanc	New	St. Maurice	Que.	1930	C. G.	.....	150	1934	160,000
Beauharnois Light, Heat & Power Co.	W. S. Lee, T. H. Hogg and F. B. Brown	Beauharnois	New	St. Lawrence	Que.	1929	P. & G.	4,500	31	1932	228,000 S.-S. U. 281,000
MacLaren Quebec Pr. Co.	Hardy S. Ferguson & Co.	Masson	New	Lievre	Que.	1931	G. C. G.	428	66	1933	136,000
Ontario Power Service Corp.	George F. Hardy	Abitibi Canyon	New	Abitibi	Ont.	1930	M. C. E.	1,600	294	1933	132,000 S.-S. U.
Ontario Hydro-Elec. Pr. Comm.	Ontario Hydro-Elec. Pr. Comm.	Rat Rapids	New	Albany	Ont.	1934	.....	.....	...	1935	1,200
Minas Basin Pulp & Pr. Co. Ltd.	Power Corp. of Can. Ltd.	St. Croix	New	St. Croix	N. S.	1933	C. G.	275	47	1935	4,200
City of Ottawa		Queen St.	New	.....	Ont.	1934	.....	.....	...	1935	.....
Altmonte Public Utilities Comm.			New	.....	Ont.	1934	.....	.....	...	1935	.....
Orillia Water, Lt. & Pr. Comm.	L. G. McNeice	Workman's Falls	New	Gull	Ont.	1934	C. G.	200	68	1935	5,200
The Yukon Consolidated Gold Corp. Ltd.			New	Klondyke	Yukon	1934	.....	.....	...	1935	5,000
Pioneer Gold Mines of B. C., Ltd.			.....	.....	B. C.	1932	.....	.....	...	1933	800
Pioneer Gold Mines of B. C., Ltd.	R. O. Udall	Hurley River	New	Hurley	B. C.	1933	Crib.	120	8	1934	1,000
Meridian Mining Co., Ltd.	A. G. Langley		.....	.....	B. C.	1933	.....	.....	...	1933	600
Canadian Dept. of Rys. & Canals		Merritton	New	Welland Canal	Ont.	1930	.....	.....	...	1932	15,000
St. Anthony Gold Mines, Ltd.			New	Sturgeon	Ont.	1934	.....	.....	...	1934	800
Newfoundland											
Anglo-Newfoundland Dev. Co., Newfoundland		Bishops Falls	.....	.....	.....	1933	.....	.....	...	1934	.....

[1]A. C. —Allis-Chalmers Mfg. Co.
M. S. —S. Morgan Smith Co.
J. L. —James Leffel & Co.
P. W. —Pelton Water Wheel Co.
I. P. M. —Baldwin Southwark Corp., I. P. Morris Div.
N. N. —Newport News Shipbuilding & Dry Dock Co.
W. —Woodward Governor Co.
L. —Lombard Governor Co.
D. E. W. —Dominion Engineering Works
C. A. C. —Canadian Allis-Chalmers Co.
M. S. I —S. Morgan Smith-Inglis Co.
G. E. —General Electric Co.
W. E. —Westinghouse Elec. & Mfg. Co.
U. S. N. —U. S. Navigation.
E. M. —Electric Machinery Mfg. Co.
C. W. E. —Canadian Westinghouse Co.
C. G. E. —Canadian General Electric Co.
A. C. O. —Ateliers de Const. Oerlikon
S. G. E. —Swedish General Elec. Co.
E. E. C. —English Electric Co.
S.-S. U. —Station-Service Units

tion in the United States and Canada in 1933 and 1934

Added Cap., No. of Units	Date of Added Cap.	Ultimate Cap., Horsepower	No. of Units Installed	Waterwheel Capacity, Horsepower	Waterwheel Type	Speed, R.p.m.	Static Head, Ft.	Design Head, Ft.	[1]Waterwheel Manuf.	Governor Manuf.	Draft Tube, Type	Scroll Case, Type	Penstock Valves, Type	Generator Capacity, Kva.	[2]Thrust-Bearing Location	Power Factor	Kilovolts	Cycles	[1]Generator Manuf.
..	....	.....	1	1,265	Kaplan	112.5	13	13	M. S.	.....	Vacuum flume		.....	.....	.....	....	.....	..	E. M.
..	....	.....	1	900	.....	.....	.....	.....	.....	.....	.....	.....	.....	875	.....	.....	.....	..	G. E.
..	....	.....	2	750	Francis	.....	.....	30	M. S.	L.	.....	.....	.....	750	.....	0.80	2.4	60	G. E.
..	....	.....	1	3,000	Francis	150	49	49	M. S.	.....	Elbow	Plate St.	.....	2,250	.....	....	.....	..	G. E.
..	....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2,500	.....	....	.....	..	G. E.
..	....	.....	1	3,250	Kaplan	171.5	28	28	I. P. M.	.....	.....	.....	.....	3,750	.....	....	.....	..	G. E.
..	....	.....	2	3,050	Prop.	171.5	28	28	I. P. M.	.....	.....	.....	.....	3,250	.....	....	.....	..	G. E.
									2-M. S.										2 G. E.
..	....	510,000	4	42,500	Kaplan	109.1	55.5	53.5	2-I. P. M.	W.	Elbow	Concrete	Head Ga.	36,000	B. G.	0.80	13.8	60	2 W. E.
..	....	.....	2	3,100	Francis	180	55.5	53.5	M. S.	W.	Elbow	Concrete	Head Ga.	2,500	B. G.	0.70	0.48	60	W. E.
1	1933	510 000	5	42,500	Kaplan	109.1	55.5	53.5	I. P. M.	W.	Elbow	Concrete	Head Ga.	36,000	B. G.	0.80	13.8	60	G. E.
1	1934	510.000	6	42,500	Kaplan	100	55.5	53.5	M. S.	W.	Elbow	Concrete	Head Ga.	37,500	B. G.	0.80	13.3	25	G. E.
1	Generator only	..	..	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1,000	.....	.....	.....	..	G. E.
1	....	.....	..	1,000	Francis	514	.....	85	I. P. M.	.....	.....	.....	.....	Connects to existing generator				..	.....
..	....	.....	1	106	.....	210	15	15	J. L.	.....	.....	.....	.....	.....	.....	.....	.....	..	.....
..	....	.....	1	155	.....	180	10	9.5	J. L.	.....	.....	.....	.....	.....	.....	.....	.....	..	E. M.
..	....	.....	1	375	Prop.	180	18	18	M. S.	W.	Conical	Open Flume	.....	312	A. G.	0.80	0.48	60	G. E.
..	....	.....	1	250	Francis	720	80	80	J. L.	J. L.	.....	.....	.....	175	.....	.....	2.3	..	G. E.
..	....	47 500	2	8,500	Kaplan	163.6	42-26	37.5	M. S.	W.	Elbow	Concrete	.....	7,500	B. G.	0.90	6	60	A. C.
			2	220	Francis	415	42-26	37.5	J. L.	W.	Elbow	Concrete	.....	150	Direct Current		0.25	..	A. C.
..	....	.....	1	340	.....	164	.....	12.5	J. L.	.....	.....	.....	.....	.....	.....	.....	.....	..	G. E.
..	....	.....	2	5.000	Kaplan	163.6	32	32	.....	.....	Elbow	Concrete	.....	3,800	B. G.	0.95	6.9	60	.....
..	....	.....	3	18.000	Francis	115	.....	112	.....	.....	Elbow	Plate St.	.....	14,000	B. G.	0.95	13.8	60	.....
..	....	.....	2	17.500	Francis	257	206	194	.....	.....	.....	.....	.....	14,500	.....	0.90	13.8	60	.....
..	....	175.000	4	35,000	Francis	150	.....	157	I. P. M.	.....	.....	.....	.....	30,000	B. G.	0.85	6.9	25	W. E.
..	....	.....	1	1,585	Kaplan	360	40	40	M. S.	.....	.....	.....	.....	1,250	A. G.	0.80	4.15	60	W. E.
..	....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	625	.....	....	.....	..	G. E.
..	....	.....	1	1 500	Francis	128.6	22.5	22.5	M. S.	.....	Elbow	Open Flume	.....	.....	.....	.....	.....	..	.....
..	....	20.850	2	6.800	Prop.	90	24	23	N. N.	W.	Elbow	Concrete	.....	6,000	B. G.	0.80	4.15	60	G. E.
			1	7.250	Kaplan	90	24	23	I. P. M.	W.	Elbow	Concrete	.....	6.000	B. G.	0.80	4.15	60	G. E.
..	....	20.850	2	6.800	Prop.	90	24	23	N. N.	W.	Elbow	Concrete	.....	6.000	B. G.	0.80	4.15	60	G. E.
			1	7.250	Kaplan	90	24	23	I. P. M.	W.	Elbow	Concrete	.....	6.000	B. G.	0.80	4.15	60	G. E.
..	....	.....	1	250	.....	180	.....	10	J. L.	.....	.....	.....	.....	.....	.....	.....	.....	..	G. E.
..	....	25.000	3	6.600	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	..	.....
..	....	.....	1	1.400	.....	180	32	32	J. L.	.....	.....	.....	.....	1,000	A. G.	0.80	0.6	60	W. E.
			1	800	.....	200	32	32	J. L.	.....	.....	.....	.....	625	A. G.	0.80	0.6	60	W. E.
..	....	.....	1	600	.....	240	42	40	J. L.	.....	.....	.....	.....	.....	.....	.....	.....	..	G. E.
..	....	.....	1	.....	.....	164	.....	.....	.....	.....	.....	.....	.....	2,500	A. G.	0.80	0.48	60	W. E.
..	....	.....	1	510	.....	164	22	22	J. L.	.....	.....	.....	.....	.....	.....	.....	.....	..	E. M.
			1	325	.....	200	22	22	J. L.	.....	.....	.....	.....	.....	.....	.....	.....	..	E. M.
..	....	132,000	2	66,000	Francis	112.5	207-130	180	N. N.	.....	Elbow	Plate St.	.....	56,000	.....	0.90	13.8	60	.....
..	....	360.000	1	45,000	Prop.	85.7	54-43	48	I. P. M.	.....	Elbow	Concrete	.....	36,000	.....	0.90	13.8	60	.....
..	....	45,000	2	15,000	Francis	171.4	126	110	M. S.	W.	Elbow	Plate St.	.....	12,500	B. G.	0.80	13.8	60	W. E.
..	....	.....	2	2.300	Francis	300	73-79	73	P. W.	P. W.	Elbow	Plate St.	.....	1,875	A. G.	0.80	2.3	60	E. M.
..	....	1,835,000	4	115.000	Francis	150 or 180	422 to 584	500	A. C.	W.	Elbow	Cast St.	Butterfly	82,500	A. G.	1.0	13.8 or 16.5	50 or 60	2 G. E. 2 W. E.
			1	55,000	Francis	237	.....	500	N. N.	W.	Elbow	Cast St.	Butterfly	40,000	A. G.	1.0	13.8	60	A. C.
			2	3.500	Pelton	300	.....	.....	P. W.	W.	House service		.....	3,000	.....	0.8	2.4	60	E. M.
..	....	100.000	..	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	..	.....
..	....	60,000	..	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	..	.....
..	....	.....	1	100	.....	900	.....	85	J. L.	.....	.....	.....	.....	.....	.....	.....	.....	..	G. E.
..	....	210.000	4	21,000	Prop.	100	51-20	32	A. C.	A. C.	Elbow	Concrete	Head Ga.	16,667	B. G.	0.90	13.8	60	G. E.
..	....	332,000	2	83,000	Francis	171.5	327-247	310	M. S.	M. S.	Elbow	Cast St.	Butterfly	66,700	A. G.	0.90	13.8	60	W. E.
..	....	4,140	2	850	Prop.	400	34	34	P. W.	P. W.	Conical	Concrete	.....	850	A. G.	0.80	2.3	60	A. C.
..	....	600,000	2	60.000	Kaplan	75	22-67	50	.....	.....	.....	.....	.....	54,000	.....	0.80	13.8	60	.....
..	....	.....	1	5,000	.....	.....	22-67	.....	.....	.....	.....	.....	.....	3,200	.....	.....	.....	..	.....
..	....	2,500.000	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	132,500	.....	0.80	.....	..	.....
..	....	.....	2	2,100	Francis	400	.....	80	M. S.	M. S.	Conical	.....	.....	1,750	.....	0.80	2.4	60	W. E.
..	....	.....	1	1.450	Pelton	428	.....	500	P. W.	.....	.....	.....	.....	.....	.....	.....	.....	..	.....
..	....	33,600	2	11,200	Francis	214.2	145-75	125	A. C.	W.	Elbow	Plate St.	Butterfly	10,000	A. G.	0.80	6.9	25	G. E.
..	....	240 000	4	40,000	Francis	109.1	117-93	108	D. E. W.	D. E. W.	Moody	Plate St.	Head Ga.	36,000	B. G.	0.85	11.0	60	C. W. C.
..	....	636.000	4	53,000	Francis	75	83	80	D. E. W.	D. E. W.	Elbow	Concrete	Head Ga.	46,625	B. G.	0.80	13.2	60	C. G. E.
														43,482	B. G.	0.85	13.2	25	C. G. E.
..	....	.....	2	8,000	Francis	180	83	80	D. E. W.	D. E. W.	Elbow	Concrete	Head Ga.	7.200	.....	0.80	13.2	60	C. G. E.
1	1934	.....	5	53,000	Francis	75	83	80	D. E. W.	D. E. W.	Elbow	Concrete	Head Ga.	43,482	B. G.	0.85	13.2	25	A. C. O.
..	....	136.000	4	34,000	Francis	166.7	203-186	185	C. A. C.	W.	Elbow	Plate St.	.....	28,000	A. G.	0.85	13.2	25	C. W. C.
..	....	330,000	2	66,000	Francis	150	247	237	C. A. C.	C. A. C.	Elbow	Plate St.	Head Ga.	48,500	A. G.	0.85	13.8	25	C. G. E.
..	....	.....	1	600	Francis	750	247	237	C. A. C.	C. A. C.	Elbow	Cast St.	.....	.....	.....	.....	.....	..	C. G. E.
..	....	.....	..	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	..	.....
..	....	4,200	1	4,200	Francis	400	161	156	D. E. W.	W.	Elbow	Plate St.	Butterfly	3,750	A. G.	0.80	2.2	60	S. G. E.
..	....	.....	1	760	Prop.	312	31	29	D. E. W.	.....	.....	Open Flume	.....	Drives 17.5-million g. p. d. centrifugal pump					
..	....	.....	1	650	Francis	257	30	30	M. S. I.	.....	.....	.....	.....	.....	.....	.....	.....	..	E. E. C.
..	....	5,200	2	2,600	Francis	277	70	66	M. S. I.	W.	.....	.....	.....	2.250	.....	0.80	2.3	60	.....
..	....	.....	1	5,000	Francis	514	.....	220	D. E. W.	.....	.....	Cast Ir.	.....	.....	.....	.....	.....	..	C. W. E.
..	....	.....	1	800	Pelton	257	.....	240	D. E. W.	.....	.....	.....	.....	.....	.....	.....	.....	..	C. W. E.
..	....	1,000	1	1,000	Francis	720	300	258	C. A. C.	W.	Steel	Cast Ir.	Gate	835	.....	0.90	6.6	60	C. G. E.
..	....	.....	1	600	Pelton	.....	.....	.....	.....	.....	.....	.....	.....	500	.....	.....	.....	..	.....
..	....	15,000	3	5,000	Francis	400	168	150	M. S. I.	M. S. I.	Elbow	.....	Butterfly	5.000	.....	0.80	6.6	66.6	C. G. E.
..	....	.....	2	400	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	..	.....
..	....	.....	1	2.200	Francis	214	35	35	.....	M. S. I.	Elbow	Open Flume	.....	.....	.....	.....	.....	..	G. E.

[1]The term "New" applies to an entirely new project on a site that has not been developed previously. "Redevelop" indicates a project on a site that has been developed previously and may consist of new wheels and settings or an entirely new plant.

[2]A. G. indicates that the thrust bearing is above the generators rotor; B. G., thrust bearing located below the rotor.

[3]G. C. G., Gravity type with control gates; R. C., reinforced concrete; P. & G., piers and gates; R. E. F., rolled earth fill; C. G., concrete gravity; M. A., multiple arch; D. R. G., diversion roller gates; G. A., gravity arch; C. A. A., constant-angle arch; M. C. E., mass concrete and earth fill with concrete retaining walls.

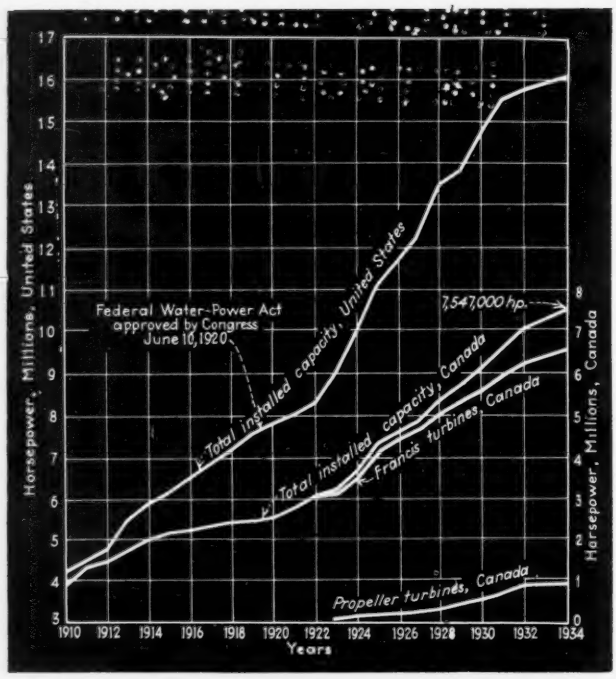


Fig. 1—Water-power growth in the United States and Canada

the larger project will undoubtedly be undertaken.

A plant capacity of about 80,000 hp. forms part of Fort Peck dam project on the Missouri River near Glasgow, Mont. Near Rawlins, Wyo., a 60,000-hp. hydro-electric project is planned on the North Platte River as part of an irrigation development.

Under direction of the Tennessee Valley Authority three great power projects are now being constructed on the Tennessee River, and others may be undertaken in the near future. The power project was started with Muscle Shoals plant at Wilson Dam as a nucleus. On the Clinch River, a tributary of the Tennessee, Norris dam 253 ft. high is being built. A 132,000-hp. plant with two 66,000-hp. units is being installed at this dam.

At the head of the reservoir formed by Wilson Dam, Joe Wheeler Dam and a plant for eight 45,000-hp. propeller-type wheels is being constructed. One of these wheels has been ordered and initial operation is planned for 1936. About 50 mi. below Wilson Dam at Pickwick Landing a third dam will be built. This will back water up to Wilson Dam and, with Joe Wheeler dam, will completely utilize a fall of over 200 ft. in about 100 mi. of the river. The power plant for Pickwick Landing Dam is planned for 300,000 hp. in six units.

Government power developments, outlined in the foregoing, with their associated projects involve an initial expenditure of over $400,000,000. In addition to these, three other projects under construction in Nebraska include a power installation totaling 100,000 hp.

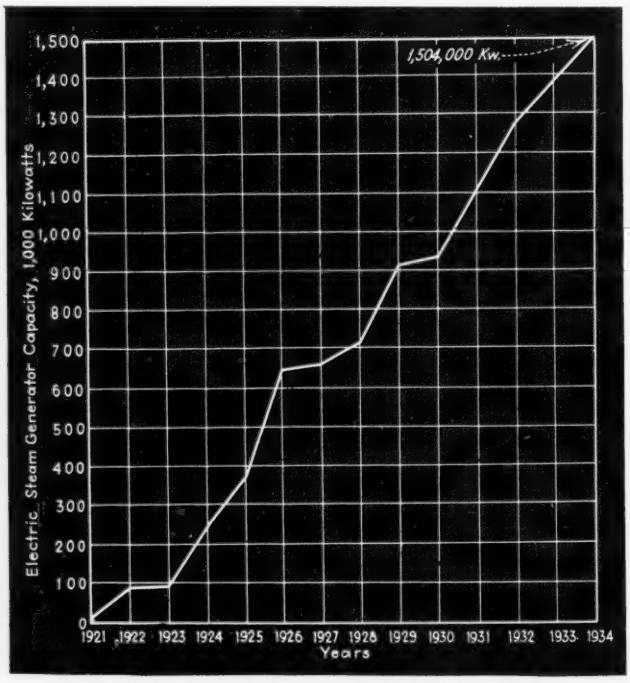
Even though total power output in Canada established an all-time record, water-power development is still suffering from effects of the business depression. With a large excess of generating capacity, for normal industrial and domestic services, in most of its centers of population, no important new projects have been attempted for several years. Considerable new capacity has gone into service each year, but this is a hang-over from boom days. During 1934 the Shawinigan Water & Power Co. started its Rapide Blanc plant, on the St. Maurice River, with an initial capacity of 140,000 hp. Beauharnois Heat, Light & Power Co. added a fifth 53,000-hp. unit to its plant on the St. Lawrence River. This company has five more units on order for installation during the next three years. These units are to supply power contracts made before construction of the plant started.

A LARGE part of the excess water-power capacity in Canada is being utilized to supply power for electric steam generation. As shown by the curve on this page, electric steam-generator capacity has been installed in Canada to absorb over 1,500,000 kw. Nearly 40 per cent of this went into service during the last four years.

Economic and industrial conditions in Canada are probably more favorable for installing electric steam generators than in the United States. However, with the large hydro-power capacity that will soon be available in the latter, it would appear that they offer greater possibilities than indicated by the few important installations that have been made. After a hydro-electric plant has been built, almost any price for power gives a better return than letting the machines stand idle and the water run over the spillway.

Information for constructing the electric steam-generator curve was supplied by Dominion Engineering Works, Ltd., Montreal; Canadian General Electric Co., Toronto; and Zenith Engineering Co., Montreal. The Bigelow Co., New Haven, Conn., assisted with data on electric steam-generation installations in the United States.

Fig. 2—Electric steam-generator growth in Canada



THESE ARE

POWER FALLACIES

In the Opinion of

P. W. Swain

Editor of POWER

If you don't agree, say so. Every engineer likes a good argument

FALLACY NO. 1: Large steam mains give reserve capacity.

The Facts: In a plant generating 7,500 lb. of steam per hour, at 100 lb. pressure, an 18-in. main 20-ft. long will store 35 cu.ft. Drawing this down to 75 lb. would replace the boiler capacity for only one second. See page 21 for proof.

Fallacy No. 2: Inefficient steam-driven feed-pumps cause no waste if their exhaust is entirely consumed in process and feed-water heating.

The Facts: True only where all the exhaust from all the steam-driven units in the plant is usefully employed. Where any exhaust steam passes to atmosphere, even though this particular steam does not come from the pumps, every pound less steam exhausted by the pumps means exactly one pound less wasted to atmosphere by the plant as a whole.

Fallacy No. 3: As soon as equipment is "written off" on the company books the power it generates suddenly becomes much cheaper.

The Facts: It does "on the books" merely because the books are wrong. When you buy a new piece of equipment you guess at the life and proceed to "write it off" at the corresponding rate. Your guess is never exactly right, so the rate of writing off is always in error.

The true yearly cost of *owning* equipment can only be determined after you are finished with it, because of depreciation or obsolescence. You can then look back and say without any guessing that a certain fixed sum deposited yearly in a bank at a certain rate of compound interest would have amounted to the first cost at the end of the (then known) life. Add interest to this to get the true yearly cost.

Fallacy No. 4: Fixed charges on equipment already installed should be considered when investigating the advantages of replacement.

The Facts: Whatever the books may show, the fact is that money spent for equipment already installed is "over the dam" whether you bought the machine for cash or must keep on paying out on it for another ten years even if you scrap it now. Nothing you do about new equipment will have any effect on these payments. Whether the machine cost you $1,000,000 or was a gift, whether it has already been "written off" or not, the answer will be just the same.

The new equipment is a good investment if the saving in *operating cost* will yield an adequate return on the new investment.

Fallacy No. 5: High CO_2 percentage in flue gas indicates better efficiency because of more complete combustion.

The Facts: Neglecting CO and solid carbon waste through grate and up stack, one pound of a given coal always produces the same amount of CO_2 regardless of the equipment used or the skill with which it is handled.

But a bag of salt dumped into a brook makes it more "salty" than if the same bag were dumped into a river —less dilution. CO_2 percentage is inversely as the *dilution* of the real products of combustion with useless air.

Thus, when CO_2 drops from 12 per cent to 6, just as much CO_2 goes up the stack as ever (if the same amount of coal is burned), but the volume of stack gases is doubled. You are running your boiler as a hot air furnace to heat "up the sky" with twice as much hot gas. Just that much less heat goes into steam.

Fallacy No. 5: High-pressure steam is much better for process use because it contains a lot more heat.

The Facts: Measured above 32 deg. F., the heat in one pound of steam at 100 lb. gage pressure is 1189 B.t.u. At 5 lb. gage pressure it is 1156 B.t.u. Assume, then, that operating conditions give a condensate temperature of 200 deg. leaving the process. Then the heat given up by one pound of steam at 100 lb. gage pressure is 1021 B.t.u., while the corresponding figure for 5 lb. pressure is 988 B.t.u. The difference is only $3\frac{1}{2}$ per cent.

Many see this point, but overlook the fact that it is not particularly significant. For example, if the steam were supplied directly from a boiler in both cases, a lower process pressure would make no change in boiler fuel consumption one way or the other, because it would merely call for slightly more pounds of low-pressure steam with slightly fewer heat units per pound.

HUMIDITY CONTROL WITH BRINE SPRAY

By Wallace H. Martin

Ore. State Agr. College

BRINE spray for cooling air for cold storage is becoming quite common. Not only is it used for holding rooms at temperatures near 32 deg., but it is being successfully adapted for maintaining temperatures as low as zero.

One of the chief advantages of brine spray for air cooling is the opportunity for fairly accurate control of humidity. The brine is cooled by ordinary methods, either in a tank containing evaporating coils or in a cooler of the baudelot type. It is then pumped to nozzles spraying into a duct through which air is forced by a fan. Another method is to place direct expansion surface in the spray chamber. The air in this case makes contact not only with the drop surfaces but with the wetted pipe surfaces.

Intimate contact between the air and brine and the fairly long spray chamber gives opportunity for the air and water vapor to reach a condition of equilibrium. With pure water the air leaves the spray chamber practically saturated, but with a salt solution the saturation point is not reached. The weaker the salt solution the more nearly saturated the air is, which is equivalent to saying that for weak salt solutions the relative humidity possible is higher than for strong solutions.

Relative humidity may be defined as the ratio of the vapor pressure of water vapor in air to the maximum vapor pressure corresponding to the temperature. As an example, at 34 deg. the maximum pressure that water vapor can exert is 0.1955 in. Hg. If it is found that the actual vapor pressure is 0.15 in. Hg. the relative humidity is $0.15/0.1955 \times 100 = 76.7$ per cent.

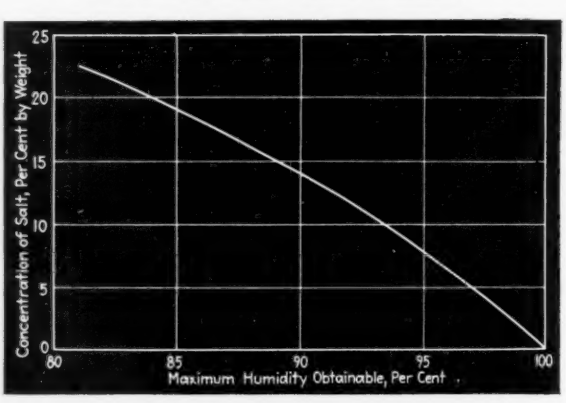
The maximum vapor pressure exerted by a salt solution, such as sodium chloride in water, is less than that exerted by pure water. The relation between the maximum vapor pressure of a sodium-chloride salt solution and the vapor pressure of water at the same temperature is shown by the curve. Fundamental data for this curve are obtained from the International Critical Tables[1] and the values are calculated by the method described by Hougen and Watson.[2] Since the abscissas of the curve represent the ratios of the two vapor pressures, they also represent the maximum relative humidity obtainable with any given strength of salt solution. With a 5% salt solution the maximum relative humidity is about 97 per cent. As the strength of the brine is increased the obtainable relative humidity is reduced.

If the goods being stored require high humidities the strength of the brine should not be any greater than necessary to prevent freezing and the range of temperature of the air should be small. Small temperature range is desirable because if the air is allowed to warm very much in passing through the room its capacity for absorbing moisture from the goods is increased and dehydration occurs.

Too fine a spray is objectionable because of the difficulty of removing all the suspended brine in the eliminators. Unless it is removed the salt is deposited in the cold-storage rooms. For this reason the pressure at the spray nozzles should be low, not more than about 7 lb. Air velocity through the spray chamber should be about 400 ft. per min.

Compared to the air washer, the spray chamber is considerably longer. A brief analysis indicates the reason. Air coming to an air washer may be at 80 deg. and be reduced to about 55 deg. by contact with a water-spray, as fine as mist, at 45 deg. Under such conditions the contact time need not be long because the mean temperature difference is great and the water surface is large, resulting in rapid heat transfer. In the case of the brine spray a typical condition is one in which the air is cooled from 33 to 29 deg. by a coarse spray at a temperature of perhaps 24 deg. The mean temperature difference is about one-third that for the air washer and the water surface is less because of the larger drops. Both of these factors tend to reduce the heat transfer rate and to require a longer time of contact, which of course means a longer spray chamber.

Salt concentration limits humidity



[1]International Critical Tables: Vol. III, p. 326.

[2]Hougen and Watson; Industrial Chemical Calculations; John Wiley & Sons: p. 437.

PLANT WILL RUN ONE SECOND ON HEADER STORAGE

By James O. G. Gibbons
Consulting Engineer

Some engineers figure that steam stored in an oversized header will tide the plant over a short peak . . . It won't; here is the proof.

MANY engineers and managers of moderate-size boiler plants, such as those of dye works, etc., where there are sudden demands for a large amount of steam, hold the opinion that a large steam header will serve as a reservoir which can be tapped when needed.

Theoretically, the steam in a large header could be drawn upon, but a few simple calculations will show that the amount of stored steam available is so very small as to be of no practical use.

To demonstrate this, let us assume that we have about 7,500 lb. per hr. of boiler capacity and that to provide some steam storage, we go to the expense of installing an 18-in. header 20 ft. long, volume about 35 cu.ft. Assuming that the pressure is 100 lb. gage, 35 cu.ft. of steam will weigh about $35 \times 0.257 = 9$ lb.

Even if we could draw all this off in any emergency, the amount is so small that it is hardly worth considering. In fact, it could replace the full boiler capacity for only 4.3 sec., if the pressure were drawn right down to a 29-in. vacuum. Suppose, on a heavy pull, we allowed the pressure to drop to 75 lb., we would then have in our header 35×0.204, or a little over 7 lb. of steam, so that all the reserve steam we could have taken from the header would be about 2 lb. Of course, when we drop the pressure in this way we automatically draw upon the heat stored in the boiler, especially in the water, to take some of the excess load. This may lead some people to imagine that they are getting the steam from the header storage. It is often hard to convince owners of this, and there is a great temptation to put in oversized headers so that all the troubles of the plant will not be blamed on the size of the piping—another example of money wasted because of engineering misconceptions.

Storage of steam in the hot water of the boiler is another matter. One cubic foot of steam at 100 lb. pressure weighs 0.257 lb., whereas one cubic foot of water at the same temperature weighs 56 lb.—218 times as much, with over 50 times the heat content. For this reason, if the pressure is allowed to drop, a considerable amount of steam may be generated from the heat stored in the boiler water, whereas any attempt to store the same amount of heat in the steam header would be prohibitive in cost.

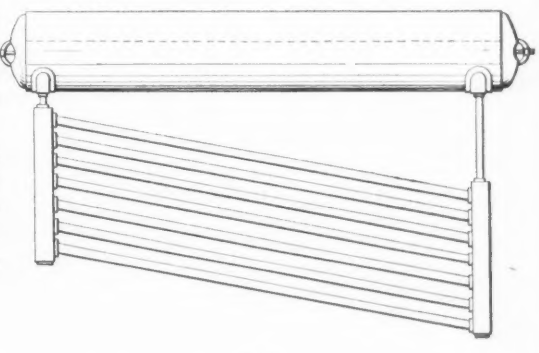


Fig. 2—Each 35 cu.ft. of water in boiler at 338 deg., weigths 56 × 35 = 1,960 lb., and will flash about 42 lb. of steam if the pressure is drawn down to 75 lb. gage

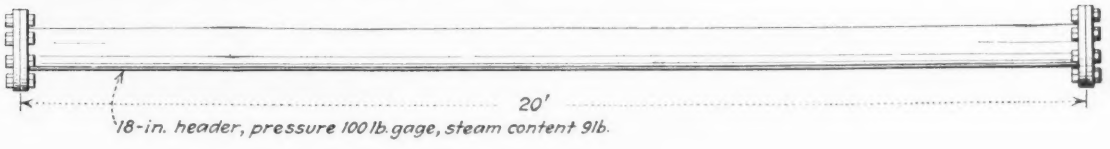


Fig. 1—18-in. header 20 ft. long holds 35 cu.ft. of steam. At 100 lb. gage this weighs 9 lb. Pressure drop to 75 lb. would deliver 2 lb.

ADJUSTMENTS REJUVENATE COMBUSTION CONTROL

By T. F. Norris

University, Va.

LIKE almost every other kind of equipment, automatic combustion control may prove a failure unless properly installed and adjusted. This was clearly demonstrated in the University of Virginia power plant, where automatic combustion-control was installed, but was abandoned as unworkable. Afterward this equipment was made to operate satisfactorily by correcting installation faults and making adjustments.

This plant is equipped with 3,000-sq.ft. boilers generating steam at 150 lb. pressure, used principally for heating. Electric power is purchased. Two boilers, installed in 1927, have single-retort underfeed stokers, forced-draft fans with constant-speed induction-motor drive, louvre damper in main air duct and automatic combustion control. Two other boilers, installed in 1930, have double-retort underfeed stokers driven by variable-speed motor or a steam engine. The combustion control system was not used on these two boilers except on the main air-duct damper which controls air supply to all four boilers. A damper regulator operates an uptake damper to give a constant minus pressure in the furnace in combination with a hand-operated windbox damper.

The automatic combustion system consisted of a master controller regulated by steam pressure in the main header and individual controllers on the windbox damper in each old boiler. The master controller operated the main air-duct damper and controlled the uptake dampers and speed of the stokers on these two boilers. A minus pressure in the furnace was maintained by individually controlled windbox dampers. This system did not work satisfactorily. As a result it was abandoned for hand operation, and new boilers installed later were not equipped for automatic operation.

During the summer of 1933 I became interested. From a study of power-plant files and testimony of men in the plant during 1927 and 1928 I learned that the control system had been very unstable. It could not be adjusted to care for variations in load. It not only failed to control but at times built up a positive pressure in the furnace chamber sufficient to blow flames through the firing doors a distance of 10 ft.

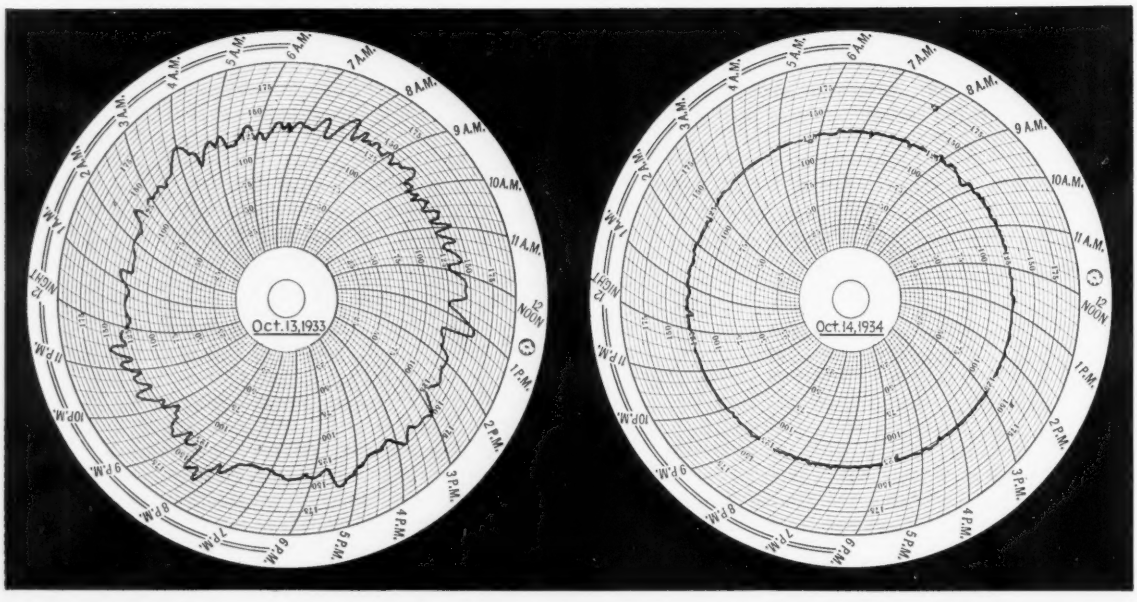
Study of the system showed that it should work, so the master controller was thoroughly overhauled and connected to the dampers and stokers as originally installed. Operation was very satisfactory and showed a decided improvement over hand operation. Some time was given to instructing the firemen and engineers in its use, overcoming their prejudice, and tuning up. Wind box dampers were then connected to their controllers (which the power-house crew claimed were the real offenders), and carefully watched to prevent accidents to firemen.

It was soon apparent that the system was unstable, as had been recorded in the power house files for 1927 and 1928. The regulators were found to have been installed with atmospheric and combustion-chamber pressure connections reversed. When this was corrected the system was stable and easily adjusted. Since then the results have been satisfactory.

Last summer the automatic combustion-control system was extended to the two new boilers without purchase of new equipment. The regulator on uptake damper was disconnected and connected through

Fig. 1—Steam-pressure chart, operation of boilers controlled manually

Fig. 2—Steam-pressure chart obtained with automatic combustion control



a small steel cable over pulleys to a lever on the windbox damper shaft to maintain a constant minus pressure in the combustion chamber by controlling windbox pressure. The uptake damper is connected by a cable to the shaft operated by the master controller. A cable from the same shaft to the stoker-engine governor regulates stoker speed. This gives full automatic control on these two boilers.

In the original installation, the master-controller shaft transmitted motion to the louvre damper in the main air duct and to uptake dampers of the two new boilers. The master-controller pilot valve is actuated by steam-header pressure; hence its movement is proportional to steam pressure or steam demand. Movement of uptake dampers is also proportional to the steam demand. The louvre damper tends to change air pressure under grates directly with load. The independent damper regulator on the windbox controls draft to suit fuel-bed conditions.

Natural draft is used on light summer load when the heating system is not in use. This last summer automatic-control system was used after forced draft was discontinued. A trap door in the main air duct on the boiler side of the louvre damper was opened to admit air, while ash doors and cleanout doors to the windbox was kept closed as usual in forced-draft operation. It was found that the boilers operated satisfactorily up to 6,000 lb. of steam per hr., maximum summer load. Under forced-draft operation these boilers can supply 18,000 lb. per hr. without difficulty.

The steam pressure charts have changed from a succession of mountains and valleys (Fig. 1) to a curve as smooth as most power plants require (Fig. 2) and the attendants now rely upon the automatic system for control. Troublesome clinkers have been eliminated even at heavy loads, though the same firemen often had difficulty with the same coal when hand control was used. Boiler efficiency increased almost 10 per cent.

UNIT HEATER PIPING

By C. C. Herman

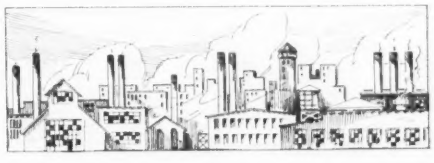
Waterloo, Iowa

UNIT heaters offer much to the industrial plant because they simplify steam distribution and return systems, conserve wall and floor space, reduce first cost, and provide units which may be used for cooling in summer. Essential in their successful operation is a properly designed piping system, with pipe sizes sufficiently large. Unfortunately, pipe sizes large enough for the usual direct radiation systems are too small for equivalent unit-heater arrangements, because unit heaters work on the "on and off" principle with low utilization factor. Further, unless both steam control valve and fan are tied in with the thermostat, as soon as the control valve closes the fan will cool the coils and blow out cold air.

This brings up another important point—the feeling of cold created by circulation of air. 70-deg. air is warm enough for workrooms if not circulated, but if circulated at high velocity (dewpoint is 58 deg., assuming a humidity of 70%) the human skin surface temperature approaches the lower temperature. Evaporation is increased due to the greater volume of air passing over the surface, consequently a sensation of cold is produced unless air temperature is raised. I was called in to look over a system which included unit heaters mixed with direct radiation. The system was of the differential type designed to work at pressures down to 25-in. vacuum. At 25-in. vacuum, steam temperature is 133 deg. F., whereas at zero gage steam temperature is 212 deg. At 5 lb. gage, at which pressure most unit heaters work, steam temperature is 227 deg. F. The difference in temperature between the steam within the radiator of the unit heater and the air flowing through the radiator openings will be about constant at 80 deg. with steam at 212 deg. F., tapering off to about 50-deg. difference with steam at 133 deg. F. This means that with steam at 133 deg. F. the air flowing from these unit heaters was around 84 deg. F. This air, when mixed with room air on its way to the working zone, was readily converted to 70-deg. air, which felt cold to workmen. The cure, of course, was to operate the steam feeding mains at higher pressure or supply steam of a higher temperature. When this was done the complaint about cold drafts from the unit heaters ceased.

Unit heaters must be supplied with a full head of steam constantly during the time the system is in use for heating. Head pressure must be high enough to provide air from the unit heater having a temperature of at least 100 deg. F. when the heater is within 5 ft. of the working zone. An air temperature lower than this will result in air feeling cold to workers.

Another trouble was encountered with one system



with which I came in contact. The units seemed to shut off automatically and blow cold air for a period, then suddenly steam would come back on and hot air would be emitted. The heaters were found to be air-bound at times which prevented the steam from entering in sufficient volume. Consequently, the heaters were working first as heaters and then as coolers. A slight change of the air trap setting eliminated the complaint.

Steam must be carried to the heater in sufficient volume to permit the unit to work at maximum rating. The unit must then be controlled by thermostats and electro-magnetic starters on the fan motors so that it is shut down when room temperature reaches a predetermined point and started up when the temperature drops a given amount, usually 3 deg.

In the design of the steam piping the matter of pressure drop must be settled first of all. This, of course, depends upon the initial pressure. However, wherever possible the very lowest pressure should be used. In general it is sufficient if zero gage pressure is achieved at the unit heater inlet. Operators can improve economy by dropping pressure at the unit heaters to 5 or 7 in. of vacuum and still be on the safe side as far as complaints are concerned. With quite accurate calculations of losses through pipe valves and fittings, the designer may "skimp" his pipe layout somewhat. This may cause considerable trouble later on unless the operators "save the day" by increasing steam pressure at the power-plant end of the heating main.

From 0.8 to 1 oz. per 100 ft. of straight pipe equivalent is considered good practice in design. Heaters should be installed as near the main as possible, and it is good practice to cover the main with 1-in. magnesia pipe covering. This is done to deliver steam to the units as dry as possible and with as high temperature as possible. Units will dissipate the heat of vaporization of the steam more efficiently than the uncovered pipes.

Traps should be installed close to the outlets of units but with sludge pockets below the traps and before entry to them. This is done by extending the drop from the heater 6 or 8 in. below the tee leading to the trap and then placing a pipe cap over the end of the drop. The drop is cleaned occasionally by removing the pipe cap.

Fig. 1 shows a conventional design of the steam piping for a unit heater installation. A maximum velocity of 75 ft. per sec. has been allowed. Allowance in feet

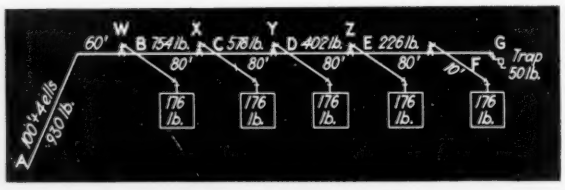


Fig. 1—Conventional steam piping arrangement for unit heaters

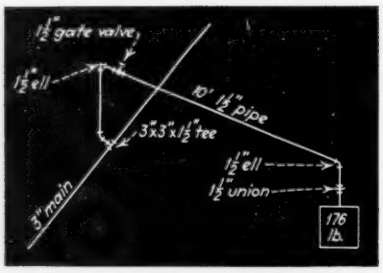


Fig. 2—Connection between unit heater and steam main

TABLE 1

Piece mark.	Load lb.	Length of pipe	Length of Fittings	Equiv. length, ft.	Size of pipe, in.	Drop per ft., lb.	Drop in., price	Total drop, lb.
A	930	160	56	216	4	0.0016	0.3456	0.346
B	754	80	..	80	4	0.0010	0.080	0.426
C	578	80	..	80	3½	0.0012	0.996	0.522
D	402	80	..	80	3	0.0013	0.104	0.626
E	226	80	..	80	2½	0.0013	0.104	0.730
F	176	10	24	34	2½	0.0008	0.026	0.756

TABLE 2

Conn. no.	Load lbs.	Pipe ft.	Ells	Equiv. pipe, ft.	Drop at point, lb.	Drop in conn., lb.	Drop per ft. pipe, lb.	Equiv. pipe, in.
W	176	10	5	35	0.3456	0.41	0.0117	1.5
X	176	10	5	35	0.426	0.33	0.0094	1.5
Y	176	10	5	35	0.522	0.234	0.0067	1.5
Z	176	10	5	35	0.626	0.13	0.0037	2.0

of pipe has been made for each fitting, also the condensate of the pipeline has been included in the total amount of steam to be delivered by the pipe. Table 1 will give the required data.

Total drop, therefore, to the most distant heater is 0.756 lb. or 12.096 oz. Total length of the pipe line to furthest heater is 490 ft., but the total equivalent pipe length is 570 ft. Drop per 100 ft. of pipe is therefore 2.1 oz., slightly higher than indicated above. But since the total drop is only 0.75 lb. rate of drop per unit of length can be slightly higher.

This drop of 0.756 lb., or 12 oz., is called the base drop. In order to insure that all radiators will receive steam at an equal rate and that the furthest radiators will heat as readily as the nearest, connections must be so designed to the rest of the radiators that the drop to each will equal this base. Referring to Fig. 1 again, consider connection *"W."*

The load at this point is 75 lb. of steam per hr. The length of pipe is 10 ft. plus 5 ells or 35 ft. of pipe. The drop in the main at the connection, from the table, is 0.3456 lb. Base drop is 0.756 lb. The required drop in the connection is 0.756 — 0.346 = 0.41 lb. Drop per foot required = 0.41/35 = 0.0117 lb. = $1\frac{1}{2}$-in. pipe.

This same method is followed in determining the pipe size to be used at each of the other connections. The data are tabulated in Table 2.

Fig. 2 illustrates how the connection is made between the unit heater and the steam main. The equivalent length of pipe due to fittings was figured as follows: For each ell we add 5 ft. of straight pipe. For each valve, the tee from the main and the entrance to heater we add an ell, making five ells total or 25 ft. of straight pipe equivalent. This added to the 10 ft. of straight pipe used in the connection makes 35 ft.

At first thought, many engineers will feel that this is considerable detail to go through in order to design a heating system. There are other methods in use, but it is quite essential that this or an equivalent method be used if the system is to be economical in installation and operation, efficient in results, uniform in heating throughout the system and quiet in operation. The latter may, in some cases, be most important.

CHECK FLUE-GAS ANALYSES WITHOUT COMPUTATION

By Prof. John G. Fairfield

Rensselaer Polytechnic Institute

AN ERROR in the Orsat flue-gas analysis will spoil all the computations for dry air supplied or dry flue-gas produced per pound of fuel fired. For a given fuel, with given CO produced, the O_2 and CO_2 must bear a certain relation to each other. The chart on page 36 shows the relation between the CO_2, O_2 and CO in the flue-gas for any given fuel. If the three gas percentages align, the analysis is consistent.

Sometimes the slightly different chart shown on this page will be more convenient. It shows the relation between the CO_2 and N_2 for any fuel so burned as to give less than 1 per cent CO, which is the case in most boiler practice.

The accompanying table gives values of the "fuel-property" *Z*, so that it is not necessary to compute it; also of the maximum percentages of CO_2 and N_2 obtainable from each fuel.

To illustrate the method of using the charts, consider this example, taken from a well-known reference book on boiler-room practice. The flue-gas and coal analyses are given below.

Coal (Weight Analysis, %)		Flue-Gas (Volume Analysis, %)	
C =	81.63 burned	CO_2 =	11.0
C =	1.25 unburned	CO =	0.2
H =	4.13	O_2 =	0.3
O =	2.61	N_2 =	88.5
N =	1.38		
S =	1.51	Sum =	100.0%
Ash =	7.49		
Sum =	100.00%		

Computing from these analyses by the standard formulas, we get the following per pound of coal burned: *A* = Actual Air Supplied = 19.57 lb.; *B* = Dry Gas Produced = 18.04 lb.

If we figure the air supplied by subtracting from *B* one pound of fuel, and adding moisture, sulphur, ash and unburned carbon, we get: *C* = Actual Air Supplied = 17.53 lb. *A* and *C* should be the same. The fact that they differ by about 10 per cent proves that the gas analysis is impossible.

To check the analysis, apply the formula and chart on page 36. Computation shows that $Z = 0.116$ and the fuel is bituminous or semi-bituminous (See table). Locate CO = 0.2 and $Z = 0.116$ on the grid in the center of the chart. Then align this point with CO_2 = 11.0 per cent. The line intersects the left-hand scale at O_2 = 8.3 per cent instead of the 0.3 in the analysis.

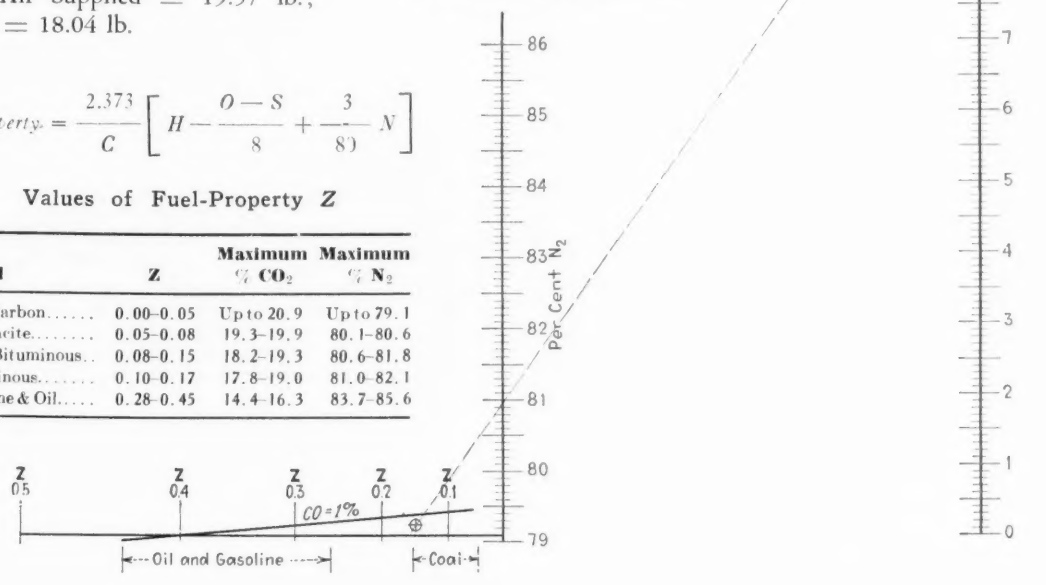
Similarly, for CO_2 = 11.0 per cent and $Z = 0.116$; the chart on this page gives 80.5 per cent N_2 instead of the 88.5 per cent given in the original analysis.

It should be clear that the routine use of either chart requires no computation whatever for a rough check on the Orsat analysis. For close work, as already indicated, use the formula on page 36 to get the value of *Z* and then apply it to the chart there shown.

$$Z = \text{Fuel Property} = \frac{2.373}{C}\left[H - \frac{O - S}{8} + \frac{3}{8}N\right]$$

Values of Fuel-Property *Z*

Fuel	Z	Maximum % CO_2	Maximum % N_2
Pure Carbon.....	0.00–0.05	Up to 20.9	Up to 79.1
Anthracite.....	0.05–0.08	19.3–19.9	80.1–80.6
Semi-Bituminous..	0.08–0.15	18.2–19.3	80.6–81.8
Bituminous.....	0.10–0.17	17.8–19.0	81.0–82.1
Gasoline & Oil.....	0.28–0.45	14.4–16.3	83.7–85.6



BUSINESS SUBMITS A

BLUEPRINT for RECOVERY

N.A.M. Joins U. S. Chamber of Commerce in drafting a program of cooperation for business and government

ON December 19, after three days of intensive conference at White Sulphur Springs, the "Joint Business Conference for Economic Recovery," first cooperative effort of the National Association of Manufacturers and the U. S. Chamber of Commerce, submitted its first blueprint for recovery, a statement of principles and an outline of recommended steps in the cooperation of business and government to end depression.

"Tentative blueprint" would, of course, be a more precise description, because this document is hardly the last word of business. It represents, in fact, a compromise of many divergent views, as well as the greatest joint effort of business men to cooperate with government to bring back prosperity.

A group of about 50 prominent business men will be formed by the Steering Committee of the White Sulphur Conference at a meeting to be held January 11. This group will elaborate and perfect the original recommendations.

The following brief excerpts cover some of the high spots of the White Sulphur report for *Power* readers interested in the general picture.

THE Joint Business Conference for Economic Recovery . . . has . . . approached its task with the conviction that patience and tolerance are requisite to the reconciliation of divergent views and the concentration of national effor. upon the one great purpose—the revival of the normal processes of industry and trade . . .

. . . The most effective solution of the problem of unemployment and relief is the creation of such confidence between industry and the government that business can proceed with plans to develop new industries, to enlarge existing enterprises and freely to place private capital in the investment field. . . .

Relief . . . is primarily the obligation of the family, of private charity, of the municipality and of the State.

The balancing of the Federal budget will . . . stimulate private initiative and increase opportunities for private employment. . . . Direct relief payments in any locality should always be materially lower than rates paid for work relief. . . .

. . . No plan of unemployment reserves can be of immediate help in relieving the present problem . . . There is, therefore, ample time for investigation.

. . . a committee should be created by business to study the practicability of a comprehensive program of social security adaptable to American conditions, giving immediate attention to unemployment reserves and old age pensions. . . .

. . . Labor cannot share what is not produced. Arbitrary determination and limitation of hours and wages as proposed in such measures as thirty-hour bills ignore this fundamental principle. . . .

The Federal government should not assume or attempt to control local relationships between employes and employers.

EMPLOYERS and employes should be free to bargain collectively or individually, in such forms as are mutually satisfactory to them without coercion from any source. . . .

Men should be protected in their right to work as well as in their right to strike. . . .

We believe that sympathetic general strikes or walkouts, blacklists and boycotts should be prohibited.

. . . The best information available indicates that further increase in the public debt beyond June 30, 1935, can be avoided. . . .

Understandings with important commercial nations to achieve stabilization of external exchanges and definite action by our government as soon as practicable to establish a standard dollar with a fixed and unvarying gold content will be of immeasurable benefit. . . .

. . . Chief among the fundamental conditions needed for recovery in the durable goods industries are (1) a free flow of private capital into private business, (2) a sound real-estate mortgage market, (3) low-construction costs necessitating removal of artificial restraints curtailing volume and increasing costs whether of material or labor. . . .

. . . The Federal Government is now competing in more than two hundred different kinds of business. . . . This destructive competition, carrying with it the threat of extension into other fields, has profoundly shaken confidence. . . .

By its own terms the National Industrial Recovery Act expires not later than June 16, 1935. . . . this conference recommends that new emergency legislation, prior to its expiring date, be enacted for a period of one year. . . .

Such legislation should be administered by an ad-

Continued on page 50

1934 OBSOLESCENCE MEASURES 1935 OPPORTUNITY

IN COLORED charts and text, the first twelve pages of the preceding number (Mid-December) presented the dramatic highlights of *Power's* equipment survey of 454 industrial plants. The survey, requiring several months to complete, was made to determine principally the age of the power generating equipment in representative plants and thus to get some idea of how American industry stands in the matter of obsolete equipment.

The present final presentation is intended particularly for the engineering reader who must eventually get down to details—for whom the dramatic broad picture, while interesting, is not enough. For him these five pages give a practically complete tabulation of the returns, industry by industry, and with them many suggestions for reducing power-service costs.

Right here, however, it is necessary to repeat, and stress even more strongly, a word of caution from the previous articles: These returns do not, even approximately, represent *average* American conditions.

The questionnaire mailing list, to start off with, represented a selection of better-than-average plants. Those replying represent a further automatic selection because, on the average, better plants are more willing to report. The final returns cover 454 plants much larger and much better than the American average.

Thus, one must avoid the temptation to turn to the chart on page 704 of Mid-December, or to any of the tables presented here, and report that a certain *industry* is much better or worse than some other in the matter of obsolete power equipment.

To bring this closer home, imagine the situation in the food industries. There are 53,000 food plants in the United States and their average installed power capacity (prime movers plus motors driven by purchased electricity) is only 9 hp. per establishment (U. S. Census of Mfgs., 1929). This average is obtained by combining an enormous number of plants running 2 or 3 hp. per plant with a few having thousands of horsepower and a fair number having hundreds. Obviously the figure of 9 hp. means nothing to the plant large enough to hire a power engineer. The 1929 U. S. Census of Manufactures covers the power capacity of 193,919 industrial establishments. Over 9 per cent of this capacity is installed in the 454 plants reported by *Power's* survey.

While, then, the survey gives no picture of the "typical" plant, if there is any such thing, it does justify four very important practical conclusions.

1. American industry, as a whole (and probably each industry classification as well) is much worse off in the matter of equipment age than are the plants reported by the tables and charts.

2. Eliminating the tens of thousands of industrials too small to employ a power engineer, the national average is still well below that of the plants surveyed.

3. Therefore, the power equipment of the average worth-while industrial plant is, in the main, old and largely obsolete.

4. This situation is additional justification for the great stress that engineering publications have laid on modernization, along with better operation and better maintenance, as a direct road to lower power costs and greater net profits in industry.

The survey shows that the average plant in any group can profit by modernization. Each engineer reader, however, can act only as an individual concerned not with an "average," but with a specific situation in a specific plant. What can he do to insure the lowest overall cost for the power services that are his immediate responsibility? The first step is a complete power survey of the plant covering at least the following:

Purchased electricity
Boiler room
Engine or turbine room
Pumping plant
Refrigerating plant
Air-compressing plant
Hook-up
Transmission and application.

Such a survey should spot dollar losses all along the line, show what could be saved by better operation, as well as by modernization, give the estimated cost of the modernization indicated.

POWER'S *equipment survey of 454 better-than-average plants shows that most of industry's power-service equipment is over ten years old, much of it over twenty. Insofar as these units are wasting more than the fixed charges on their modern counterparts, they say "Come and get it" to those seeking more profits through reduction of manufacturing costs.*

BOILERS

Industry	No. Replies	FIRE TUBE 1 to 10 No.	FIRE TUBE 1 to 10 Sq.Ft.	FIRE TUBE 11 to 20 No.	FIRE TUBE 11 to 20 Sq.Ft.	FIRE TUBE Over 20 No.	FIRE TUBE Over 20 Sq.Ft.	WATER TUBE 1 to 10 No.	WATER TUBE 1 to 10 Sq.Ft.	WATER TUBE 11 to 20 No.	WATER TUBE 11 to 20 Sq.Ft.	WATER TUBE Over 20 No.	WATER TUBE Over 20 Sq.Ft.
Food	72	30	45,630	42	51,550	21	25,000	50	274,410	120	474,050	187	580,390
Textile	58	22	35,000	91	160,200	133	280,430	56	297,040	108	469,590	72	259,650
Forest Prod	27	8	42,300	15	26,450	50	130,900	34	280,100	19	97,500	9	31,500
Paper	43	15	51,450	19	50,420	9	25,800	49	249,470	88	405,450	58	155,100
Chemical	50	9	25,800	34	32,600	11	13,700	77	521,990	84	342,850	26	84,500
Petroleum & Coal Prod	20	5	5,000	6	8,750	8	12,000	25	168,610	75	330,010	11	42,000
Rubber	16	...	.....	2	3,000	15	38,000	9	64,960	47	257,600	8	132,500
Leather	17	11	14,250	4	6,000	14	19,200	13	52,000	16	61,500	5	16,540
Stone, Clay & Glass Prod	18	13	55,700	6	8,000	3	4,500	36	288,620	16	65,580	22	72,450
Iron & Steel	28	7	19,190	6	16,500	18	24,600	40	453,700	93	483,730	131	501,220
Non-ferrous Metals	16	4	17,750	13	21,000	31	41,400	11	51,930	26	115,160	23	99,670
Machinery	53	7	11,360	23	41,210	16	21,400	38	200,330	63	255,760	77	231,370
Transport. Equipt	13	7	11,250	9	17,500	2	3,000	17	129,890	19	134,760	30	79,240
Miscellaneous	23	20	15,000	8	10,580	8	11,060	20	134,140	29	213,400	24	90,280
Total	454	158	349,680	278	453,760	339	654,990	475	3,167,190	803	3,706,940	683	2,376,410
Percentage in each Age Group	....	20	24	36	31	44	45	24	34	41	40	35	29
Reporting	....	57	56	82	81	96	75	176	173	174	171	99	96

BOILER ACCESSORIES

Industry	Superheaters 1-10	Superheaters 11-20	Superheaters Ov. 20	Air Preheaters 1-10	Air Preheaters 11-20	Air Preheaters Ov. 20	Economizers 1-10	Economizers 11-20	Economizers Ov. 20	Forced-Draft Fans 1-10	Forced-Draft Fans 11-20	Forced-Draft Fans Ov. 20	Induced-Draft Fans 1-10	Induced-Draft Fans 11-20	Induced-Draft Fans Ov. 20
Food	27	7	2	11	0	0	11	10	4	37	16	2	26	14	1
Textiles	35	60	24	3	0	0	4	12	11	45	44	8	6	8	3
Forest Prod	21	6	0	0	0	0	4	0	0	14	1	0	9	0	0
Paper	27	39	11	13	0	0	16	13	5	41	19	4	22	12	2
Chemical	32	3	0	17	0	0	8	4	1	61	9	0	24	10	0
Petroleum & Coal Prod	29	41	11	3	0	0	3	2	4	14	17	4	3	0	0
Rubber	6	24	0	2	0	0	1	6	0	6	27	0	2	6	0
Leather	3	8	0	0	0	0	0	0	1	7	6	0	0	0	0
Stone, Clay & Glass Prod	27	6	4	3	0	0	10	0	0	18	2	1	15	3	0
Iron & Steel	44	35	38	5	0	0	2	0	1	40	27	0	19	8	3
Non-ferrous Metals	1	25	6	0	0	0	0	9	6	5	14	0	2	8	2
Machinery	25	21	10	6	2	0	2	3	3	32	18	6	5	1	0
Transport, Equipt	12	9	16	0	0	0	0	0	0	16	9	0	0	1	0
Miscellaneous	12	23	0	0	0	0	7	11	.....	15	11	1	2	4	0
Total	301	307	122	63	2	0	70	70	36	351	220	26	135	75	11
Percentage	41	42	17	97	3	0	40	40	20	59	37	4	61	34	5
Reporting	100	60	19	33	1	0	28	24	19	149	90	13	65	24	8

PRIME MOVERS

Industry	STEAM ENGINES 1 to 10 No.	STEAM ENGINES 1 to 10 Hp.	STEAM ENGINES 11 to 20 No.	STEAM ENGINES 11 to 20 Hp.	STEAM ENGINES Ov. 20 No.	STEAM ENGINES Ov. 20 Hp.	STEAM TURBINES 1 to 20 No.	STEAM TURBINES 1 to 20 Hp.	STEAM TURBINES 11 to 20 No.	STEAM TURBINES 11 to 20 Hp.	STEAM TURBINES Ov. 20 No.	STEAM TURBINES Ov. 20 Hp.
Food	23	6,755	72	22,147	103	36,329	33	36,951	14	35,780	4	8,250
Textiles	9	5,655	33	12,175	46	17,125	21	28,426	42	58,392	16	25,562
Forest Prod	8	1,800	13	3,475	24	12,065	17	50,267	16	15,600	2	1,350
Paper	20	6,251	60	16,301	45	16,165	36	66,548	30	43,167	8	5,720
Chemical	17	4,234	33	5,260	9	1,430	44	37,390	16	13,610	2	2,500
Petroleum & Coal Prod	30	1,125	87	11,100	9	7,200	22	4,305	26	6,634	0	0
Rubber	1	1,000	6	1,100	3	1,500	11	22,750	9	4,250	0	0
Leather	0	0	6	2,710	15	4,260	3	6,450	6	11,600	1	1,350
Stone, Clay & Glass Prod	2	275	9	4,700	11	1,260	23	41,097	12	4,350	7	18,100
Iron & Steel	5	1,310	16	4,035	74	173,335	14	95,600	19	47,030	10	23,900
Non-ferrous Metals	5	500	12	1,135	15	5,505	4	10,358	74	26,128	3	1,480
Machinery	7	9,496	20	8,760	48	10,199	15	10,840	28	25,148	10	7,816
Transport, Equipt	4	1,400	9	1,950	2	800	10	8,466	23	26,750	3	1,210
Miscellaneous	8	4,325	9	4,040	25	7,795	12	26,300	8	6,600	6	615
Total	139	44,126	385	98,888	429	294,959	265	445,748	263	325,579	72	97,853
Percentage	15	10	40	23	45	67	44	51	44	37	12	128
Reporting	70	68	124	120	148	144	127	119	116	112	40	3

FIRING EQUIPMENT

Hand-Fired Grates			Hand Stokers			Auto. Stokers			Pulverizers			Oil Burners			Gas Burners		
1-10	11-20	Ov. 20	1-10	11-20	Ov. 20	1-10	11-20	Ov. 20	1-10	11-20	Ov. 20	1-10	11-20	Ov. 20	1-10	11-20	Ov. 20
14	20	16	8	4	1	48	87	139	35	0	0	34	21	61	17	12	26
44	87	95	0	12	3	44	94	22	24	10	0	51	28	7	0	0	0
10	8	15	3	2	7	32	6	11	3	0	0	1	0	0	3	0	0
5	7	6	1	4	0	51	70	37	38	4	0	15	12	0	0	0	0
2	41	5	0	0	0	67	42	12	22	0	0	25	44	0	0	0	0
5	6	0	3	0	0	5	17	9	5	0	0	37	52	2	65	28	2
0	5	9	0	2	0	8	45	0	6	1	0	0	0	0	0	0	0
8	12	13	0	1	0	6	15	5	0	0	0	2	0	0	0	0	0
4	6	3	1	0	0	27	11	10	7	0	0	7	0	0	0	3	0
0	20	109	0	3	0	35	90	2	11	1	0	27	7	24	17	25	74
3	13	6	4	32	0	9	30	11	0	0	0	10	0	0	0	0	0
6	33	26	2	7	2	37	54	44	5	0	0	18	0	0	2	2	0
1	10	8	0	1	2	18	14	4	11	0	0	15	4	2	4	0	0
9	7	7	3	2	4	28	15	8	4	0	0	15	0	0	0	0	0
71	275	318	25	70	19	416	590	314	171	16	0	257	168	96	108	70	102
11	41	48	22	61	17	31	45	24	91	9	0	49	32	19	39	25	36
36	66	64	65	17	7	151	124	44	59	6	0	63	28	8	23	8	6

FEEDWATER SYSTEMS

Centrl. Feed Pumps			Recip. Feed Pumps			Closed Heaters			Open Heaters			Chem. Softeners			Zeol. Softeners		
1-10	11-20	Ov. 20	1-10	11-20	Ov. 20	1-10	11-20	Ov. 20	1-10	11-20	Ov. 20	1-10	11-20	Ov. 20	1-10	11-20	Ov. 2
17	10	1	64	79	74	9	6	3	24	28	14	16	4	1	25	6	0
32	27	5	44	63	19	10	22	4	24	21	10	4	2	0	24	11	0
13	3	0	15	14	15	4	4	4	10	6	5	3	0	0	2	2	0
49	23	3	12	24	12	9	2	2	17	23	6	6	6	0	21	6	0
40	11	0	28	39	10	11	0	0	33	14	8	9	3	0	21	2	0
24	12	0	10	18	2	3	2	0	11	12	2	5	11	0	5	1	0
7	6	0	10	7	0	1	0	2	8	6	2	1	2	1	4	0	0
3	5	0	3	16	4	0	4	1	1	5	2	0	1	0	2	3	9
13	1	0	12	15	5	9	1	0	5	4	3	9	0	1	9	0	0
19	26	3	8	27	18	7	3	2	10	20	10	5	10	2	3	1	0
2	9	2	5	10	12	3	11	0	1	6	2	2	2	1	2	1	0
38	5	1	35	33	25	8	5	6	14	24	8	6	7	1	14	2	0
15	5	0	12	6	2	2	0	0	6	4	2	2	2	0	3	0	0
24	5	1	22	11	4	8	1	1	5	4	2	3	3	0	7	1	0
302	158	16	280	362	202	84	61	25	169	177	76	71	53	7	142	36	0
64	33	3	33	43	24	49	36	15	40	42	18	55	40	5	80	20	0
147	71	11	160	170	79	73	44	23	146	144	56	65	44	6	76	30	.....

GENERATORS

WATER WHEELS						A.C. UNITS						D.C. UNITS					
1 to 10		11 to 20		Ov. 20		1 to 10		11 to 20		Ov. 20		1 to 10		11 to 20		Ov. 20	
No.	Hp.	No.	Hp.	No.	Hp.	No.	Kva.	No.	Kva.	No.	Kva.	No.	Kw.	No.	Kw.	No.	Kw.
0	0	0	0	0	0	27	36,083	27	42,919	14	18,080	15	8,994	33	8,122	13	2,588
3	2,516	4	850	54	6,680	32	51,326	69	76,472	30	34,558	33	4,050	19	3,917	27	2,925
0	0	0	0	0	0	23	33,086	18	15,810	13	6,782	7	1,144	4	273	8	480
17	22,090	61	32,850	63	30,350	34	62,212	53	63,501	9	7,725	12	5,326	15	1,928	9	1,875
0	0	0	0	0	0	38	48,198	27	14,610	4	1,620	16	2,170	7	928	3	275
0	0	0	0	0	0	24	13,830	15	6,355	0	0	7	725	5	1,470	11	7,575
0	0	0	0	0	0	6	22,125	8	5,737	0	0	7	1,820	1	50	2	230
0	0	0	0	0	0	3	6,087	8	10,625	3	2,500	6	1,225	14	4,950	5	365
0	0	0	0	0	0	17	38,840	10	7,315	9	5,525	23	4,777	10	1,541	6	1,280
0	0	0	0	0	0	10	58,015	25	61,495	8	16,800	4	1,150	10	5,000	21	6,570
0	0	0	0	0	0	2	5,600	8	10,944	2	1,100	3	730	12	3,460	7	2,265
0	0	0	0	0	0	17	19,839	21	31,886	8	10,100	9	4,255	34	12,980	36	7,545
0	0	0	0	0	0	6	8,000	4	20,000	2	1,225	8	2,375	7	775	1	100
0	0	0	0	0	0	10	19,770	9	78,140	7	1,025	4	1,250	7	3,542	5	1,420
20	24,605	65	33,700	117	37,030	249	423,011	302	445,803	109	107,040	154	39,995	178	48,936	154	35,463
10	26	32	35	58	39	38	47	46	41	16	12	32	32	36	39	32	29
10	10	15	15	15	15	141	138	144	142	58	57	83	81	91	91	79	78

Industry	Meter Steam?		Meter Boiler R. Output?		Meter Steam to Eng. or Turbs.?		Meter Steam to Mfg. Depts.?		Use Process Steam?		Use Steam for Heat?		Use Steam Condensers?		How Many?
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	
Food	31	38	30	13	22	18	33	10	55	9	67	4	25	38	159
Textile	39	17	29	15	20	25	31	14	53	3	57	1	28	28	56
Forest Prod	9	16	5	12	5	12	7	11	14	9	20	6	12	12	24
Paper	36	6	33	4	22	13	24	11	43	0	43	0	19	23	33
Chemical	11	7	36	6	23	9	35	8	47	0	48	2	17	24	54
Petroleum & Coal	11	7	10	5	8	7	9	7	14	3	17	1	5	11	36
Rubber	12	2	8	4	5	6	7	6	15	0	15	0	4	8	11
Leather	4	12	1	6	3	3	3	4	14	2	16	1	3	10	7
Stone, Clay & Glass	13	3	13	2	8	5	10	5	10	7	16	1	10	7	21
Iron & Steel	19	9	12	8	9	9	15	7	17	10	25	1	13	11	55
Non-ferrous Metals	10	5	6	5	7	3	11	2	13	2	16	0	6	8	21
Machinery	31	21	25	8	17	15	25	12	35	14	51	2	19	30	55
Transport. Equipt	9	3	7	3	2	6	6	3	11	1	13	0	2	9	3
Miscellaneous	14	6	16	2	8	8	12	5	22	1	23	0	7	12	11
Total	279	152	231	93	159	139	228	105	363	61	427	19	170	231	546
Percentages	65	35	71	29	53	47	69	31	81	19	96	4	42	58	...

This, of course, is a laborious task, yet time spent on a survey is well spent, even if no new equipment is installed. The discovery and stoppage of operating losses alone should pay for it many times over.

If electricity is now purchased, study the available rate schedules carefully. Be sure you are on the schedule giving lowest cost for your plant. Study the effect of demand charges on your power bills. See how much could be saved by demand-limiting devices or alarms.

Before starting any boiler-room modernization, check the plant heat balance and consider the probable trend of that heat balance during the next ten or fifteen years. If this study indicates substantial savings from higher steam pressures avoid putting into existing boilers money that could be better spent on entirely new high-pressure units.

The following comments, however, are based on the assumption that existing pressures are found satisfactory. First, consider fuel. Would a change from oil to coal or coal to oil save enough to warrant the cost of the change? If so, might the predicted benefits be cancelled by some future change in relative prices? Experience shows that oil and coal prices change considerably over a period of years, and they do not always go up and down together. The engineer must therefore ask himself whether the change can be so made that he can shift back to the original fuel quickly and cheaply, if market changes warrant.

Considering coal only, flexible firing equipment gives the plant a tremendous advantage. This is particularly true of stokers. If they are large enough so that the furnace may be fired to high ratings with low-fusion-temperature ash, without clinker trouble, the engineer can purchase practically any coal that gives the greatest number of heat units per dollar. In this way alone he may often save the equivalent of 50 to 75 cents per ton of coal.

Ample furnace volume is necessary for efficiency and for smokeless combustion. High efficiency involves both high CO_2 and high furnace temperature. But high temperature is likely to damage furnace walls, unless they are protected by air or water cooling. Thus it is often possible to increase both the capacity and efficiency of an old boiler (and at the same time reduce smoke) by raising the setting and applying water or air cooling to the walls.

Before doing this, however, investigate the alternative possibilities of installing an entirely new boiler, holding the old units as reserve capacity.

In many cases it will pay to use air preheaters or economizers, or both, with the new unit.

Soot and scale have ceased to be necessary nuisances. Soot blowers should be installed and will pay out quickly. In every case water should be treated or conditioned by modern scientific methods. It is a fact that practically any kind of water can be so treated as to eliminate both scale and corrosion.

If heat balance is bad, look to the steam-driven reciprocating pumps. Exhaust steam will be greatly reduced by turbine-driven centrifugal pumps, and still more by electrically driven pumps.

Modernization must consider also the possible savings from the use of superheaters, feed-water regulators, etc., and the greater convenience, better operation, lower maintenance and greater safety obtainable with the most modern types of water columns, blowdown valves and other boiler accessories.

Certain instruments, as practically all engineers now recognize, are essential to good efficiency. These include CO_2 recorders, or combination steam-and-air-flow meters, to maintain the correct ratio of air to fuel, flue-gas recording thermometers, flow meters for feed water and steam, recording thermometers for feed temperature and steam temperature, pressure recorders for feed water and steam.

Mechanical handling of fuel and ash has become almost universal in good plants.

It goes without saying that any general plant study should include a complete analysis of the relative cost of purchased and home-made power. This becomes exceedingly important when a modernization program is under consideration. The same study should, of course,

QUESTIONS

FEEDWATER							FUEL							
Meter Feed-water?		Use Continuous Blowdown?		Control Feedwater By			Weigh Fuel Recd.?		Weigh Fuel to Boilers?		Handle Fuel Mechanically?		Handle Ash Mechanically?	
Yes	No	Yes	No	Hand?	Auto.?	Both?	Yes	No	Yes	No	Yes	No	Yes	No
37	42	11	56	37	34	0	29	36	38	26	29	31	13	45
44	13	10	47	24	30	4	19	37	42	14	40	13	21	31
11	26	6	20	13	14	0	3	23	7	20	17	9	4	22
33	9	13	28	10	31	1	31	25	28	12	39	2	21	17
35	14	12	36	21	26	2	21	25	30	18	36	11	15	27
22	4	10	6	4	12	0	7	6	8	8	9	4	7	5
12	2	2	12	4	10	0	8	6	11	4	10	4	4	10
7	9	1	13	11	6	0	7	7	10	6	7	9	4	12
8	9	5	12	1	16	0	5	8	6	7	12	3	6	8
21	7	6	22	14	14	0	14	12	15	12	19	7	14	12
9	7	1	12	8	5	1	5	10	6	9	9	6	4	11
30	20	9	40	22	30	0	21	29	31	21	30	21	22	29
6	7	3	9	3	10	0	3	6	8	4	8	3	4	6
15	7	5	15	12	9	0	5	16	13	9	12	11	9	14
270	166	94	328	184	247	8	160	246	253	170	277	134	148	249
62	38	22	78	42	56	2	39	61	60	40	67	33	37	63

cover the relative advantages of steam engines and steam turbines and diesel engines, and of their various combinations, and should also look into the matter of higher pressure and of condenser-bleeder operation versus straight back-pressure operation.

Pumping is generally looked upon as an incidental service. Yet in no other place is there greater opportunity for a very large return on money invested. Pump efficiencies have improved enormously in recent years. In many cases, the replacement of old pumps by the latest units, intelligently selected and driven for the existing conditions, will pay the entire cost of the changeover in one or two years. Space does not permit outlining similar opportunities in refrigeration and air compressing.

Every modernization survey should include a study of the recent and greatly improved types of mechanical transmission, particularly the advantages to be gained by a judicious combination of electric and mechanical drive. A primary step toward elimination of waste in application is the metering of power services to individual departments. Nothing the engineer can do will yield a larger return on the investment.

It has been impossible to do more than suggest where some of the savings may be made. Each engineer must make his own study. The point is that 1934 obsolescence measures 1935 opportunity, that almost every plant holds many possibilities for savings and that these should be checked at once to avoid being caught unprepared by the rising tide of business.

LOADS AND MODERNIZATION

Industry	No Replies	Kw.-hr. Used Year Ending June 30, 1934 Generated	Purchased	Per Cent of Normal Operation	Intend to Remodel Power Facilities Within: One Year	Two Years	Probably Two Yrs.	Changes to Involve Steam Generation	Heat and Vent.	Air Cond.	Power Gener.	Refrig.	Pumping	Changes to Be Made Step by Step? Yes	No
Food	72	262,280,098	39,445,503	74	14	5	10	16	8	5	10	15	11	19	1
Textile	58	231,919,229	71,970,759	70	12	5	3	14	4	3	12	1	7	13	4
Forest Prod	27	181,467,232	6,644,840	45	4	2	2	5	1	..	6	1	4	8	0
Paper	43	539,520,040	120,646,780	73	6	14	7	22	10	6	22	2	15	23	3
Chemical	50	158,451,374	66,968,803	72	8	7	9	17	4	7	16	5	9	13	5
Petroleum & Coal Prod	20	70,909,850	68,892,160	79	3	5	1	7	1	..	5	1	4	8	0
Rubber	16	62,157,000	97,091,585	77	3	1	3	3	3	2	4	2	5	4	1
Leather	17	30,312,066	4,911,100	78	2	3	0	4	0	0	2	0	1	4	1
Stone, Clay & Glass Prod	18	111,287,340	45,333,640	58	2	3	0	4	0	1	4	0	3	3	0
Iron & Steel	28	421,564,166	57,764,480	60	5	3	2	9	2	..	5	0	5	9	0
Non-ferrous Metals	16	28,041,915	35,016,080	64	2	1	0	3	1	0	2	0	2	1	1
Machinery	53	100,331,570	113,054,017	53	9	4	3	14	3	..	12	1	5	9	2
Transport. Equipt	13	43,247,430	29,507,300	73	1	2	1	3	2	..	3	0	2	2	1
Miscellaneous	23	91,737,008	22,425,615	69	3	2	0	2	2	1	4	1	2	4	1
Total	454	2,333,226,318	779,672,662	....	74	57	41	123	41	25	107	29	75	120	20
Percentage	....	75	25	67.5	16.3	12.6	9.0	25.9	7.4	4.5	22.6	5.2	15.9	25.5	3.8
Reporting	....	271	269	377											

HOW TO BURN
CRACKED FUEL OILS

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THE primary purpose of the cracking process, of which cracked fuel oil is a byproduct, is to produce a greater yield of gasoline. It also results in a gasoline of better grade than is obtainable with ordinary distillation methods. Chemical changes produced in the cracking process give the fuel oil inherently slow-burning qualities.

Principal problems to be expected when burning cracked fuel are: (a) formation of tank sludges and deposits either from the instability of the oil itself or from instability which results on mixing of different oils in the tank. (b) Formation of hard carbon deposits in the fuel oil heaters. (c) Combustion difficulties resulting in objectionable quantities of stack solids, ash deposits on the fire sides of tubes and in the furnace, excessive carbon deposits on atomizers, slagging of brickwork and lowered combustion efficiency.

The slow burning characteristic of cracked oil is manifested by somewhat longer, lazier flames. To obtain optimum burning conditions, atomization of the oil should be perfect, the best viscosity for atomization should be used, and excess air should be kept at a minimum.

It has been found with previous oils that the best atomizing viscosity is 150 seconds Saybolt Universal. This figure holds for practically all cracked oils which have been examined to date. Increasing the viscosity to 225 S.S.U. results in little and, in some cases, no loss in over-all efficiency. In some cases this higher viscosity is slightly advantageous, both as regards over-all efficiency and reduction in the amount of stack solids or fly ash.

It sometimes happens that the temperature corresponding to the optimum viscosity is above the flash point of the oil. Burning oil above the flash point will cause an apparent increase in the spray angle of the sprayer plate in use. This condition may result in flame impingement on tubes or brickwork, which usually causes an increase in the amount of stacks solids as well as a decrease in the burning efficiency. Consequently, in such cases, it is desirable to lower the atomizing temperature, thereby increasing viscosity so that atomization takes place below the flash point of the oil. An increase in viscosity from 150 S.S.U. to 225 S.S.U. will allow a decrease in temperature of approximately 18 deg. which will generally be sufficient.

Excess air decreases the furnace temperature and shortens flame length. Both of these conditions are inimical to good combustion of the relatively slow burning oil. For these oils it is possible that the operation with traces of smoke may not give the most efficient combustion. A slightly greater amount of excess air may improve the completeness of combustion and reduce the amount of stack solids, provided the excess air does not lower furnace temperature.

High combustion efficiency is intimately related to fineness of atomization. Fineness of atomization, in turn, is intimately related to the design of the oil-burning equipment, the viscosity of the oil, and the pressure at which atomization occurs. It has been found in numerous tests that atomization becomes increasingly coarser at pressures below 225 lb. pressure. In the case of cracked oils this figure is more nearly 250 lb. For this reason oil should be furnished to the atomizers at pressures not less than 250 lb. and allowance should be made for pressure drop between the gage and the atomizer.

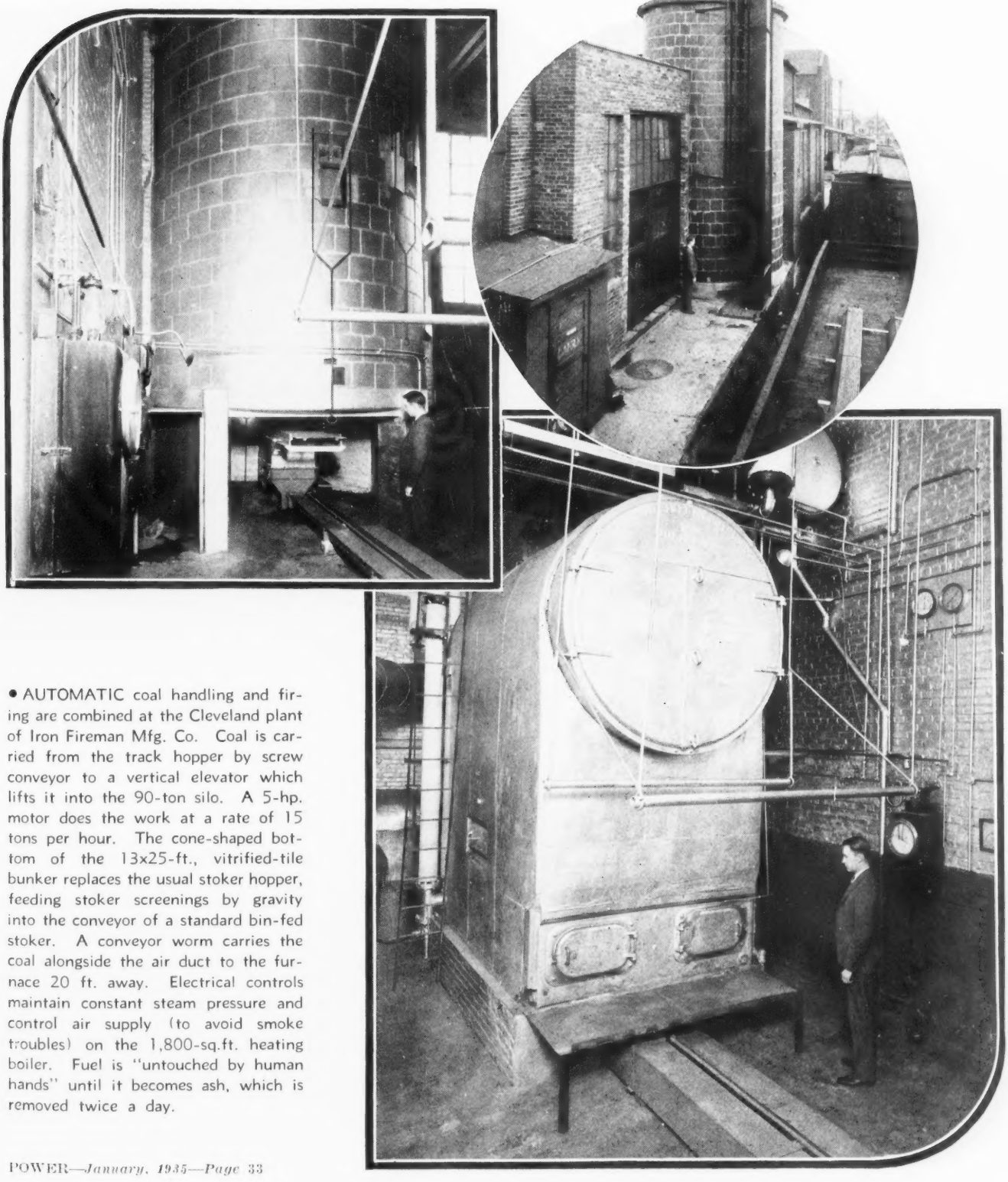
The tendency of cracked oils to produce deposits on the ends of the atomizers and on impellers is much more pronounced than with straight-run oils. It is believed that the conditions which adversely affect good combustion are conducive also to carbon building up on the ends of the burners.

The danger of fuel-oil heater deposits is an ever-present menace with these fuels. Heater deposits can be said to be a function of the temperature to which the oils are heated. The higher the temperature the greater the possibility of forming deposits and the greater the amount of fouling. Consequently small temperature differentials both in the heater itself and between the heater and atomizer are highly desirable. Effective heat insulation of fuel-oil heaters themselves and the fuel-oil piping to the burners will do much to decrease the temperature differential.

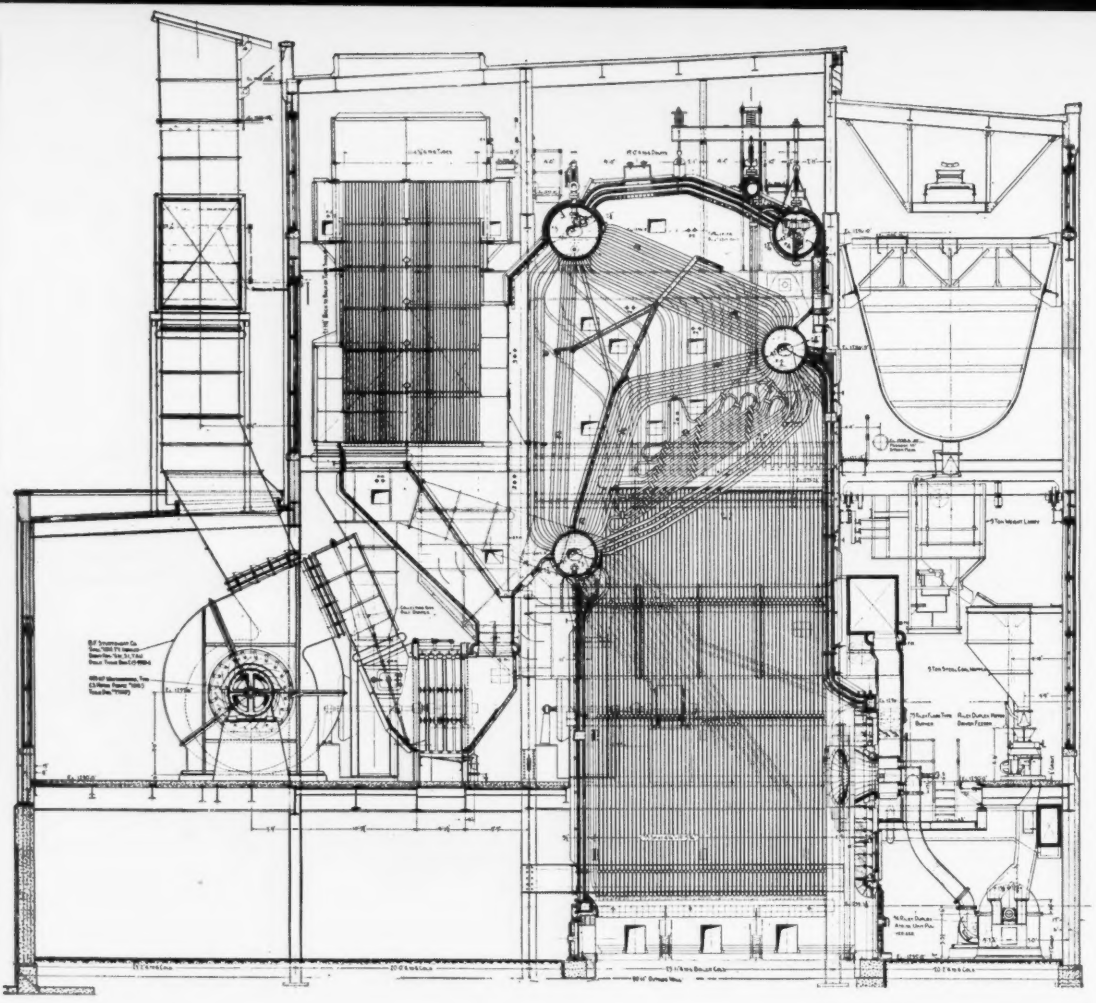
In conclusion it may be stated that the burning of cracked fuel oils is attended with more difficulty than the burning of the previous straight-run residues. These difficulties are not insurmountable and require mainly a better and closer maintenance of optimum furnace conditions.

*Abstract from "Journal of the American Society of Naval Engineers."

Mechanicoaling



• AUTOMATIC coal handling and firing are combined at the Cleveland plant of Iron Fireman Mfg. Co. Coal is carried from the track hopper by screw conveyor to a vertical elevator which lifts it into the 90-ton silo. A 5-hp. motor does the work at a rate of 15 tons per hour. The cone-shaped bottom of the 13x25-ft., vitrified-tile bunker replaces the usual stoker hopper, feeding stoker screenings by gravity into the conveyor of a standard bin-fed stoker. A conveyor worm carries the coal alongside the air duct to the furnace 20 ft. away. Electrical controls maintain constant steam pressure and control air supply (to avoid smoke troubles) on the 1,800-sq.ft. heating boiler. Fuel is "untouched by human hands" until it becomes ash, which is removed twice a day.



THE
COVINGTON PLANT
OF W. VA. PULP &
PAPER COMPANY
375,000 lbs./hr.
600 lbs. pressure
750°F. Steam
Temperature
Complete Riley Steam
Generating Unit

West Virginia Pulp and Paper Co. installs large RILEY *Steam Generating Units*

The West Virginia Pulp and Paper Company, one of the country's largest manufacturers of quality papers, have recently installed Riley Steam Generating Units for both the Luke, Maryland, and Covington, Virginia, plants. These Riley units will each develop 375,000 pounds of steam per hour at 630 and 600 pounds pressure respectively with total steam temperatures of 700°F and 750°F.

These units are complete Riley units, consisting of Riley Boilers, Riley Superheaters, Riley Water-cooled Furnaces, Riley Air Preheaters, Riley Steel-clad Insulated Settings, Riley Pulverizers, Riley Burners and Riley Flue Gas Scrubbers.

If you are interested in the economical generation of steam, visit some of the plants where Riley units have been recently installed. You will find outstanding performance, complete satisfaction, trouble-free operation, and a minimum of maintenance.

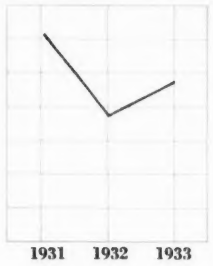
Be sure to consult Riley when considering steam generating or fuel-burning equipment. You can rely on Riley.

TRADE MARK Rx REGISTERED

RILEY STOKER CORPORATION WORCESTER, MASS.

BOSTON NEW YORK PHILADELPHIA PITTSBURGH BUFFALO CLEVELAND DETROIT
TACOMA ST. LOUIS CINCINNATI HOUSTON CHICAGO ST. PAUL KANSAS CITY DENVER
LOS ANGELES JACKSON, MISS. ATLANTA EL PASO SALT LAKE CITY NEW ORLEANS

THERE IS A VERY DEFINITE SWING TO RILEY STEAM GENERATING UNITS

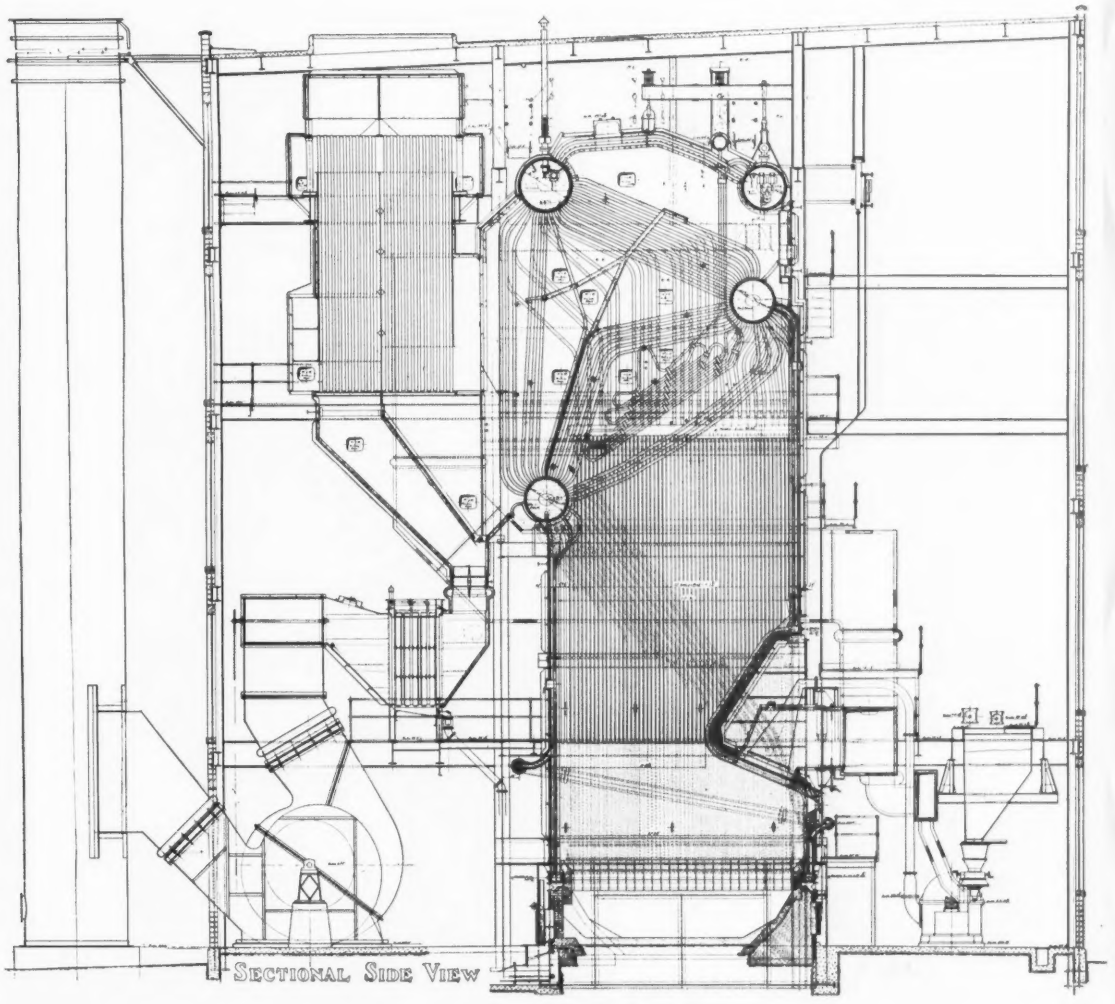


While this was happening to total boiler sales of the country

Riley Boiler Sales were jumping up like this

A FEW COMPANIES WHO HAVE SWUNG TO RILEY UNITS

W. Va. Pulp & Paper Co. . . Covington, Va.
W. Va. Pulp & Paper Co. . . . Luke, Md.
A Large Eastern Oil Refinery
Kalamazoo Vegetable Parchment Co. Mich.
Forstmann Woolen Co. . . . Passaic, N. J.
Forstmann Woolen Co. . . . Garfield, N. J.
Pennsylvania Sugar Co. . . Philadelphia, Pa.
Continental Distilling Co. Philadelphia, Pa.
Jacob Dold Packing Co. . . . Buffalo, N. Y.
General Aniline Co. . . . . Grasselli, N. J.
Hamilton Woolen Co. . Southbridge, Mass.
Finch Pruyn Co. . . . . Glens Falls, N. Y.
Columbia University . . . New York City
American Oak Leather Co. . Louisville, Ky.
Container Corp. . . . . Philadelphia, Pa.
Container Corp. . . . . Philadelphia, Pa.
Titanium Pigment Co. . . . Sayreville, N. J.
Savannah Sugar Co. . . . Savannah, Ga.
Beechnut Packing Co. . Canajoharie, N. Y.
Crompton & Knowles Loom Works
Worcester, Mass.
German Brewery . . . . Cumberland, Md.
Arnold Print Works . . North Adams, Mass.



Sectional Side View

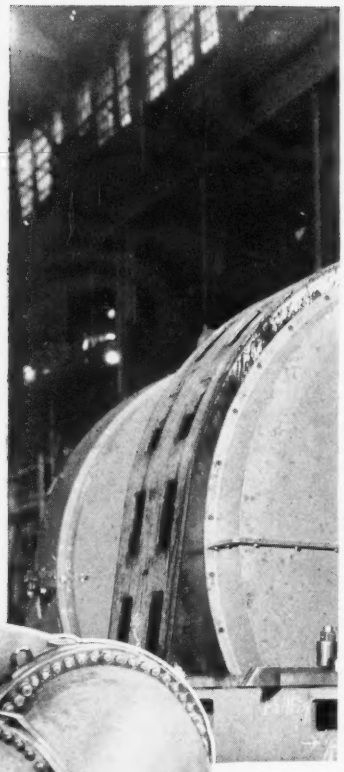
THE LUKE, MD., PLANT OF W. VA. PULP & PAPER COMPANY
375,000 lbs./hr.
630 lbs. pressure.
700°F. Steam-Slag Tap Furnace
Complete Riley Steam Generating Unit

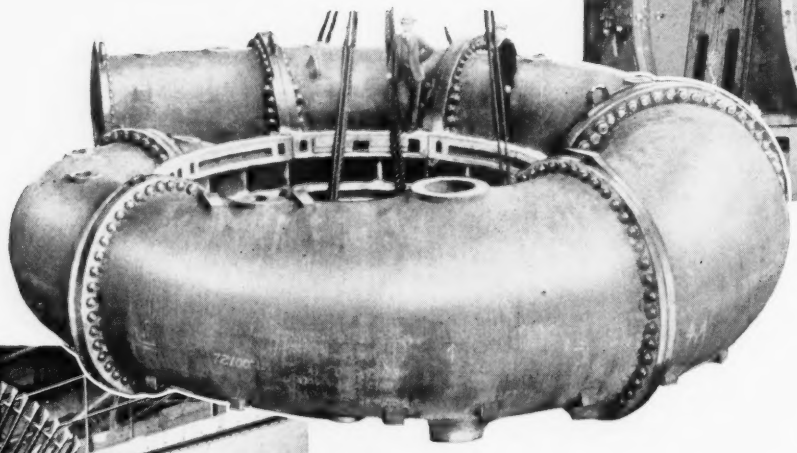
COMPLETE STEAM GENERATING UNITS

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • AIR HEATERS
ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD SETTINGS • FLUE GAS SCRUBBERS

POWER IN 1934

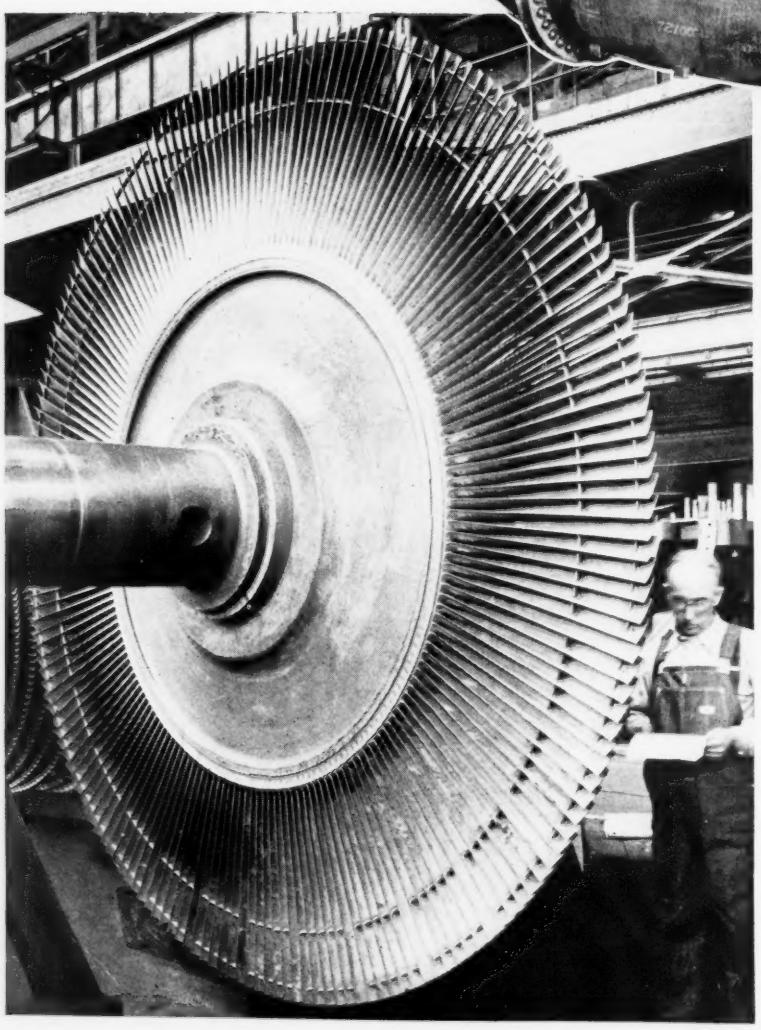
SIX photographs show what's new in steam, diesel, hydro, and pumping plants and in driving motors





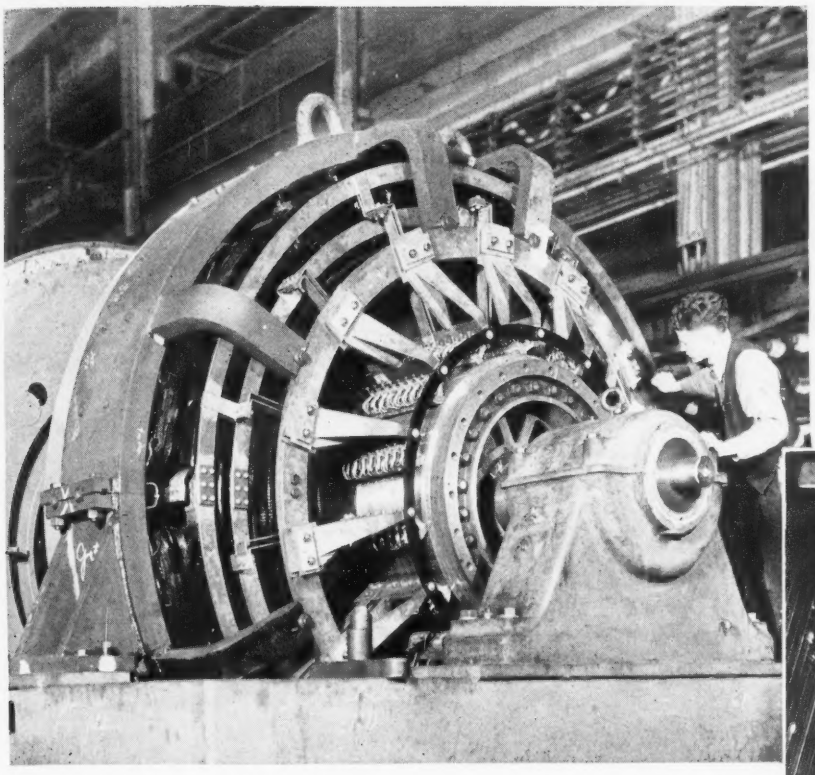
Above—One of four cast-steel spiral casings of the 115,000-hp. turbines for Boulder Power Plant being assembled at the erection shops. It will weigh 450,000 lb.

Photo courtesy Allis-Chalmers Mfg. Co.



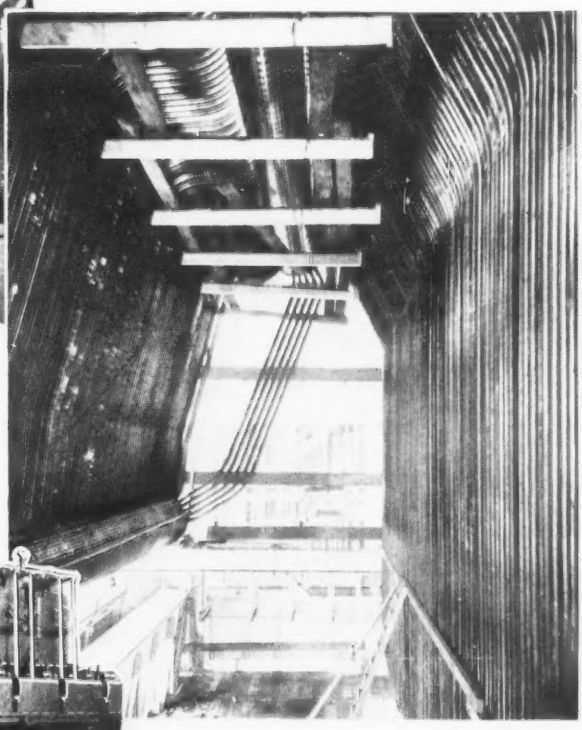
Left—Low-pressure wheel for the 165,000-kw. tandem-compound turbine soon to be installed at Richmond St. Station of Philadelphia Electric Co. Steam will be supplied to it by two new 600,000-lb. per hr. boilers at 400 lb. and 850 deg.

Photo courtesy Westinghouse

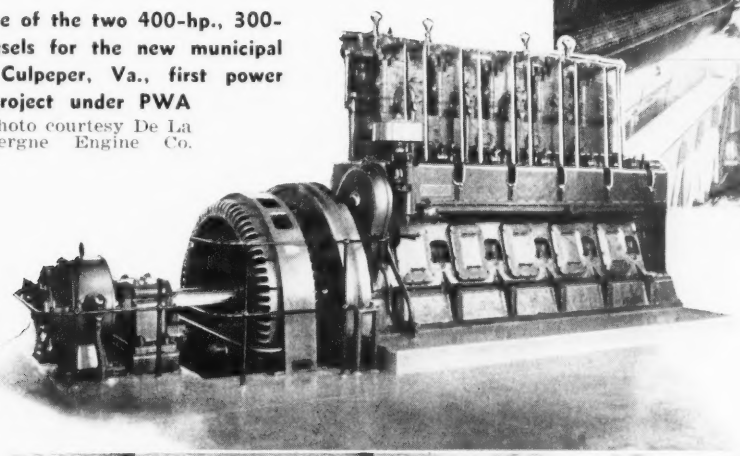


Left—Testing the first of two motor-generator sets being built for Youngstown Sheet & Tube. It will be rated 6,000 kw., 600 volts, 360 r.p.m.
Photo courtesy Westinghouse

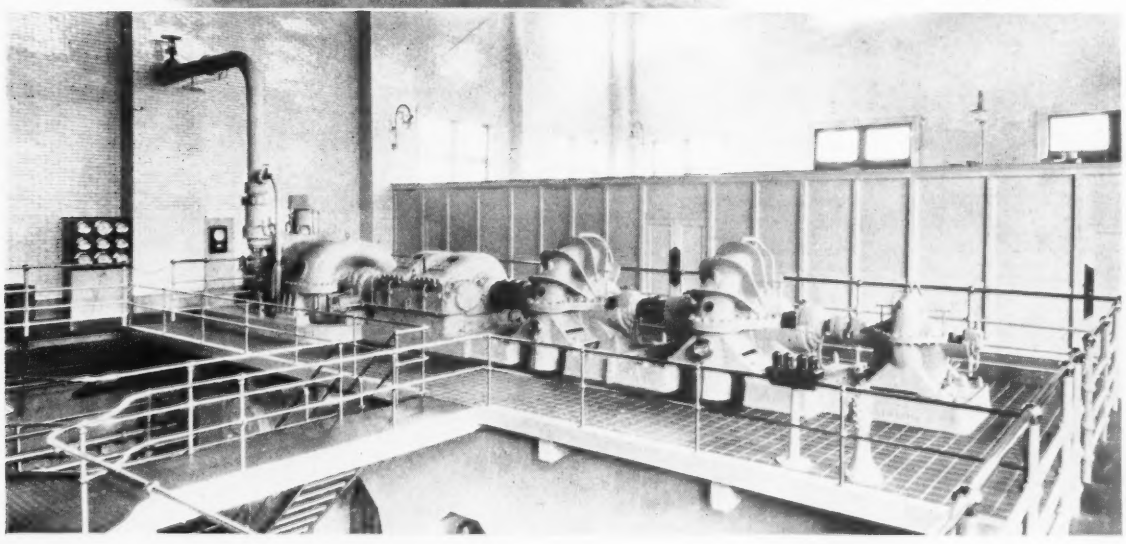
Below—Pulverized-coal boiler for Port Washington Station of Milwaukee Electric Ry. & Light Co., only new central station under construction. Pressure will be 1,390 lb., temperature 850 deg. Maximum output 690,000 lb. per hr.
Photo courtesy Combustion Engrg. Co.



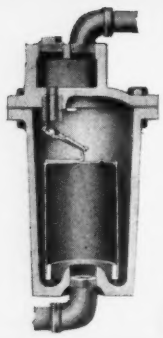
Right—One of the two 400-hp., 300-r.p.m., diesels for the new municipal plant of Culpeper, Va., first power project under PWA
Photo courtesy De La Vergne Engine Co.



Below—Steam-turbine - driven, 25,000,000 - g.p.d., 470 - ft. head centrifugal pump in Eastern Hill Waterworks, Cincinnati
Photo courtesy Worthington Pump & Mchry. Corp.



IF STEAM TRAPS WERE YOU WOULD SEE THE ARMSTRONG



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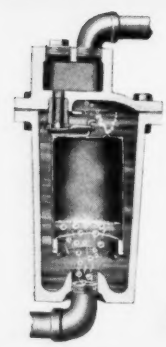


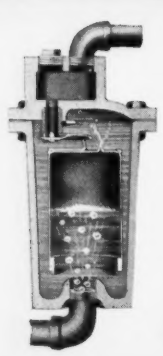
3

Our glass-bodied demonstrator, operating at 5 lb. pressure, gives most engineers a brand new idea of what happens inside a steam trap. When you actually see this trap working as you can in our demonstrator, you understand immediately some of the advantages which engineers have been finding in Armstrong Traps for many years. These demonstrations are made at conventions, power shows, and before engineers' societies.

● ● ●

The 7 small sectional views show clearly the operation of an Armstrong trap. 1. Connected into a line but not yet in service. 2. Water completely fills trap body. 3. Steam in inverted bucket floats it, closing valve. 4. Condensate entering with steam raises water level in bucket and reduces buoyancy. 5. Bucket weight pulls valve open. 6. Steam again collecting in bucket. 7. Buoyancy again sufficient to float bucket and close valve.

Above trap is a glass demonstrator using the actual operating parts of a real trap.



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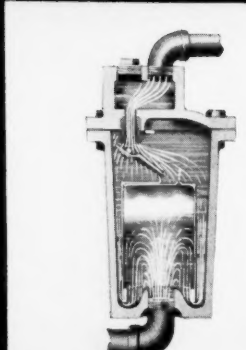

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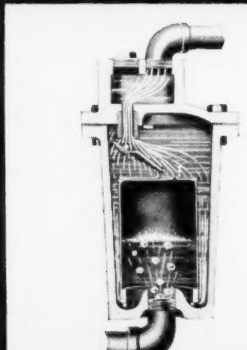

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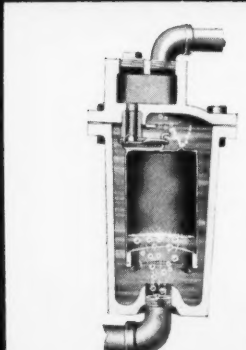


7

ALWAYS MADE OF GLASS

"Hidden Values" IN AN

The phantom view above shows what the actual trap would look like if you could see through the body.

AN Armstrong Trap in service *looks* much like many other traps. You can't *see* the free-floating mechanism, operating without friction, and practically without wear. You can't *see* the glass-hard valve and seat—and the extra quality that went into every part. You can't *see* the thermic air by-pass which makes a blast trap out of any standard Armstrong Trap.

You can't even *see* the coal saving being effected by the rapid and positive handling of condensate and air. You can't *see* the speeding up of processes made possible by these traps. But all these advantages are actually in an Armstrong Trap. They are the hidden values. Why not investigate these facts for yourself? You can do it at no cost by accepting our 90-day free trial of one or more traps. Just tell us the steam pressure and the service for which they are desired.

ARMSTRONG · TRADE MARK · "INVERTED BUCKET" STEAM TRAP

ARMSTRONG MACHINE WORKS

812 Maple Street, Three Rivers, Michigan

Number 28

FLUE GAS ANALYSIS CHECKING CHART

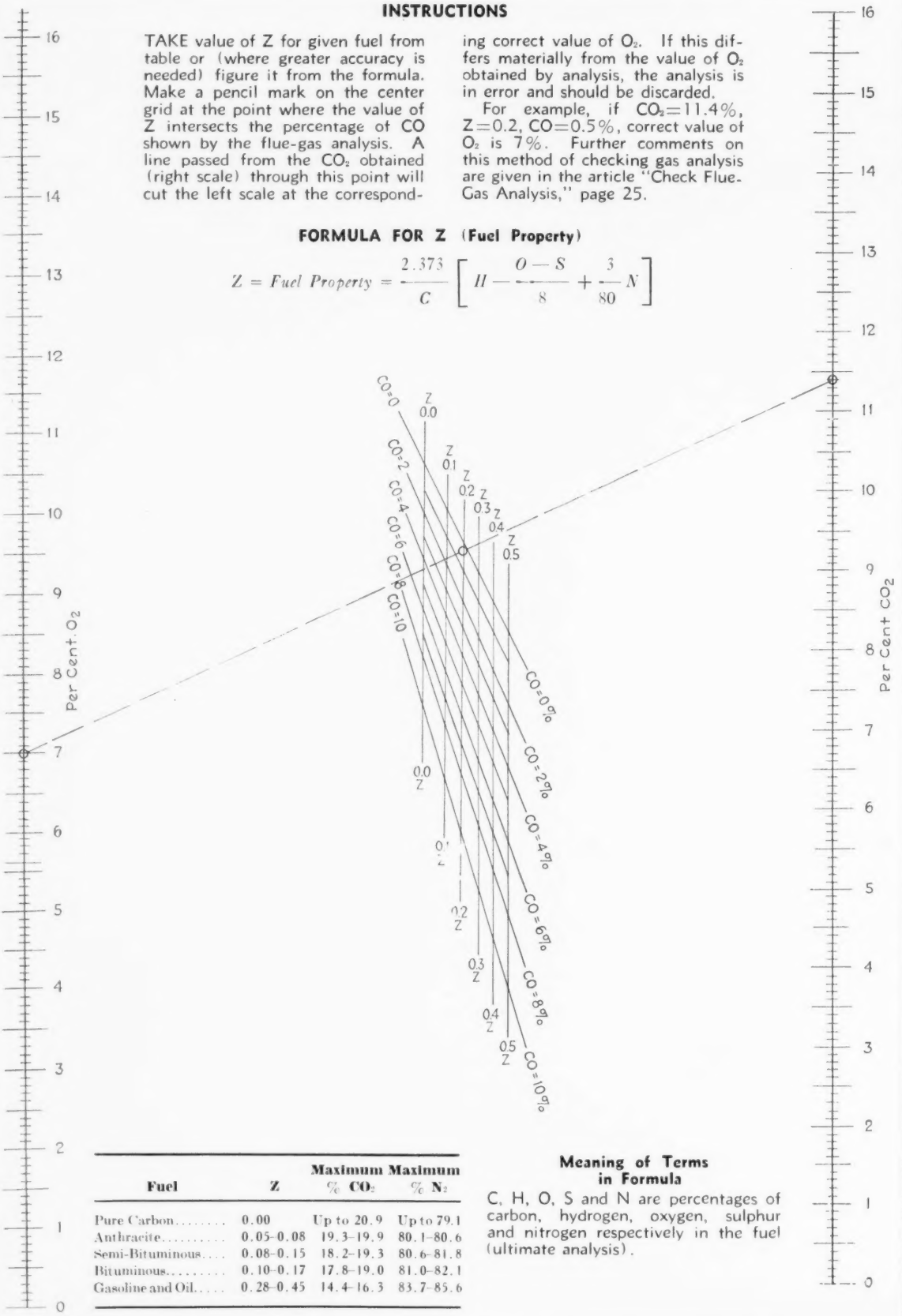
INSTRUCTIONS

TAKE value of Z for given fuel from table or (where greater accuracy is needed) figure it from the formula. Make a pencil mark on the center grid at the point where the value of Z intersects the percentage of CO shown by the flue-gas analysis. A line passed from the CO_2 obtained (right scale) through this point will cut the left scale at the corresponding correct value of O_2. If this differs materially from the value of O_2 obtained by analysis, the analysis is in error and should be discarded.

For example, if $CO_2 = 11.4\%$, $Z = 0.2$, $CO = 0.5\%$, correct value of O_2 is 7%. Further comments on this method of checking gas analysis are given in the article "Check Flue-Gas Analysis," page 25.

FORMULA FOR Z (Fuel Property)

$$Z = \text{Fuel Property} = \frac{2.373}{C}\left[H - \frac{O - S}{8} + \frac{3}{80}N\right]$$



Fuel	Z	Maximum % CO_2	Maximum % N_2
Pure Carbon	0.00	Up to 20.9	Up to 79.1
Anthracite	0.05–0.08	19.3–19.9	80.1–80.6
Semi-Bituminous	0.08–0.15	18.2–19.3	80.6–81.8
Bituminous	0.10–0.17	17.8–19.0	81.0–82.1
Gasoline and Oil	0.28–0.45	14.4–16.3	83.7–85.6

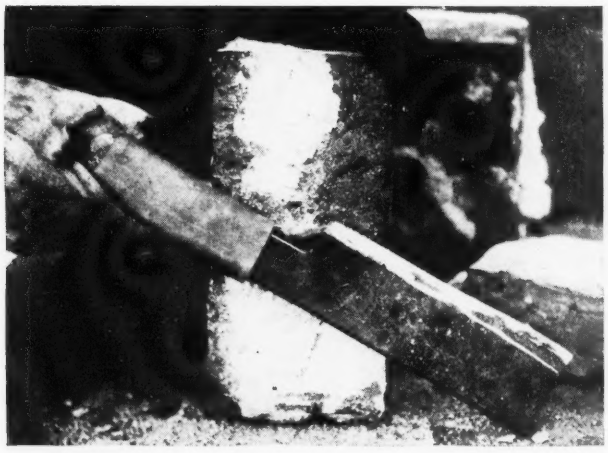
Meaning of Terms in Formula

C, H, O, S and N are percentages of carbon, hydrogen, oxygen, sulphur and nitrogen respectively in the fuel (ultimate analysis).

By Prof. John G. Fairfield, Rensselaer Polytechnic Institute

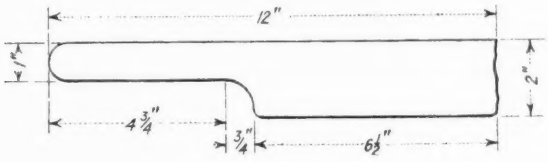
© POWER

PRACTICAL AIDS TO OPERATION



Brick Cleaning Cleaver Made From Automobile Spring

It is, of course, a matter of sensible economy when resetting a boiler to clean off and reuse as many of the old brick as possible. Homemade brick-cleaning tools are often made from various odds and ends that are not always easily handled. Frequently it is tiring on hands and wrist to use them. It may be difficult to find some old piece of thin soft steel heavy enough to chip mortar and other filler from the brick. Old automobile springs, however, can be worked into a neat easily handled cleaver-like tool for this purpose, as in the photo. The diagram shows the dimensions for such a cleaver. No attempt should be made to harden the steel of such



springs. The steel in cooling will possess sufficient hardness to allow a considerable period of use on mortar-covered brick before resharpening. A piece of old tire inner tubing can be rolled and cemented on the handle to afford a more comfortable grip and save work gloves.

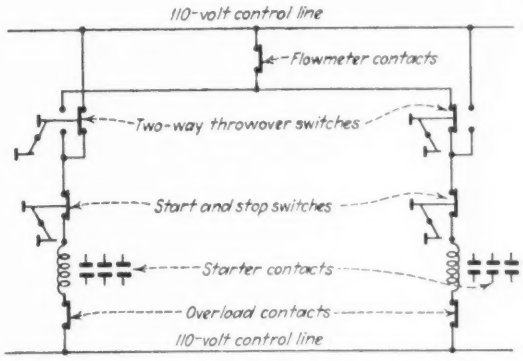
Missouri Valley, Iowa — Frank Bentley

Automatic Control for Two Pumps in Parallel

After a filtration plant was installed on a water system, the pump that discharged into the water main could not maintain sufficient head at maximum discharge. This pump, however, could take care of requirements most of the time. It was therefore decided to install a duplicate pump in parallel with the original to operate automatically when needed. A pressure regulator could not be used to control this pump. If the auxiliary pump was started on low-pressure, it would immediately build up the pressure and the regulator would shut it down.

A flow device constructed like a butterfly valve with the disk hung off center (so that the flow tended to open it) was placed in the pipe to start and stop the pump. The disk shaft was restrained from turning by a spiral spring. A mercoid switch mounted on the disk shaft controlled the motor and a flow-indicating pointer. When flow reaches a predetermined value, the mercoid switch closes the control circuit for the auxiliary pump to maintain pressure. When flow again drops below the cut-in value, the pump is shut down as the mercoid switch opens the control circuit.

The diagram indicates the control connections in a general way. The two-way throwover switch allows connecting either pump for continuous operation or for auxiliary service. As shown in the diagram, the two-way switch in the left-hand control circuit is in position for continuous operation. When the start and stop switch



is closed, a circuit is completed through the starter coil from one 110-volt control line to the other. In the right-hand control circuit the two-way throwover switch is in position for control of the pump through the flowmeter contact. At high rates of flow, this contact is closed and the auxiliary pump is started to maintain pressure in the water system. When the flow decreases until the flowmeter contact opens, the pump is stopped.

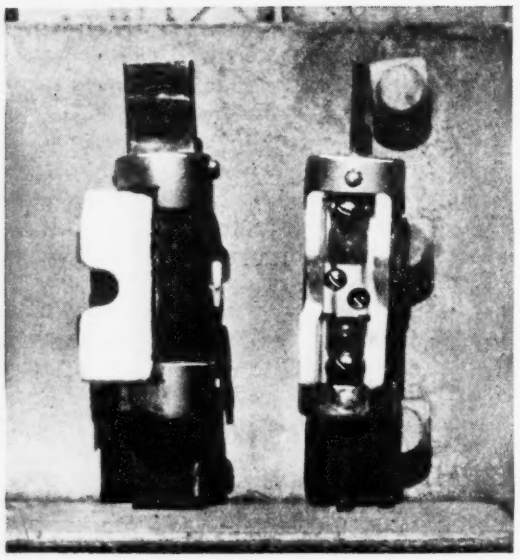
Montague City, Mass. — Max Pafenbach

Small Fuse Adapted for Use in Heavy Clips

We recently installed a telephone signal system at one of our substations that handles local dispatching. To eliminate risk of losing power on the signal system it was designed for operation off the 125-volt station control battery.

The battery distribution panel had several spare switches available, but all were equipped with clips for 200-amp., 250-volt cartridge fuses. The first thought was to use 10-amp. links in renewable fuse cases of the proper size and mark the case accordingly. There would, however, always be the risk of overfusing later, as we do not stock a 10-amp. link for this size case.

The final solution is shown in the photo. Two old non-renewable cases were cut out to accommodate a porcelain 30-amp. cartridge-fuse block. The block is bushed behind with a piece of wood to fit inside the fuse case



and bolted securely into place with $\frac{3}{16}$-in. machine screws.

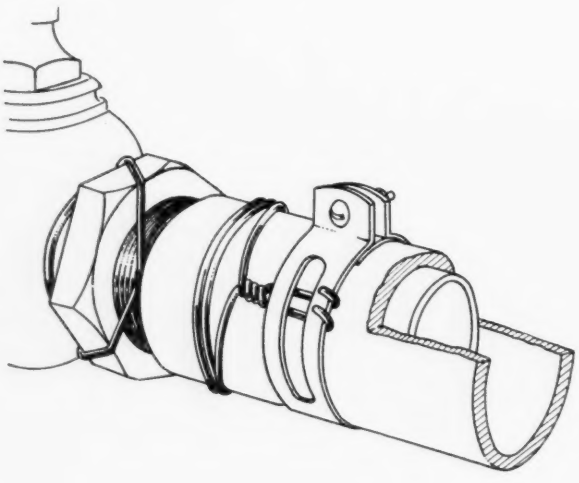
Connections were soldered to the ferrules of the large fuses and made up to the small blocks in the usual manner. The space under the porcelain block was then filled with sealing wax to stiffen the whole assembly. It was found necessary to put a small bolt through each ferrule, as cutting away so much of the fibre case made it too loose. Of course no marking is necessary to show that the fuse is special, which will eliminate any danger of accidentally overfusing the circuit later.

Nashville, Tenn. T. E. MILLER

Safety-First Steam-Hose Connections

As a safety-first practice, the proper steam-hose clamps and connections should be used around the plant. In power-plant operation, however, there are times when such equipment is not available. In some instances I have found hose ends loosely secured by hay wire, which often breaks or allows the end of the hose to blow off when the steam valve is opened. If wire must be used for this purpose, then anchor the galvanized-iron wire around the valve or connection, pass it around the steam hose and clamp the whole together with a hose clamp, as in the diagram, if a steam-clamp connection is not available.

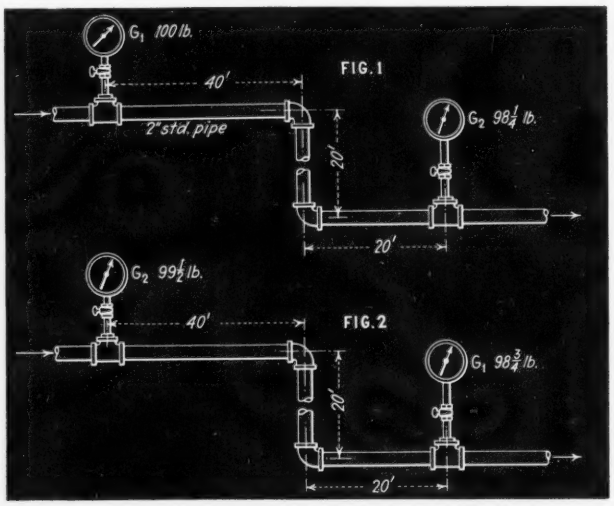
Vancouver, B. C. S. H. COOKE



Pressure Drop in Pipe Line Used to Estimate Flow

WHEN selecting a steam-pressure reducing valve, best results may be expected by avoiding oversizes. The larger the valve is, the less it will rise off its seat for a given flow. At low rates of flow the lift of an over-size valve may be so small as to cause serious cutting and pitting of the seat and disk. Valve manufacturers' recommendations give valve sizes for a given maximum flow, but frequently the problem is how to determine the flow. If a flow meter is not available, or the condensate cannot be trapped and weighed, the flow may be approximated by measuring the drop in pressure in run of pipe, if one can be found of sufficient length.

Engineers' handbooks state the relationship between flow, pipe size, initial pressure, and drop in pressure per 100 or 1,000 ft. of pipe. However, as the drop in pressure is usually small, it may be difficult to measure it accurately by ordinary means. If common pressure gages are employed for the purpose, the slightest error in the gages will introduce a large error in the result. By taking a second set of readings with the gages interchanged, then



averaging results, gage error will be eliminated or at least reduced. The diagrams show how this test may be made.

Assume that there is 80 ft. of 2-in. standard pipe between gage G_1 and gage G_2 with two elbows and one tee, allowing half of a tee for each gage connection. The elbows are each equivalent to 3.5 ft. of pipe and the tee to 1.75 ft., therefore all three fittings are equivalent to 8.75 ft. of additional pipe, making the total equivalent length between gages 88.75 ft. Suppose the pressure drop between gages, Fig. 1, is 1.75 lb. When the gages are interchanged as in Fig. 2, if the drop becomes 0.75 lb., the average drop would then be 1.25 lb. For 100 ft. of pipe the average drop would be $(1.25 \div 88.75) \times 100 = 1.41$ lb. Such a drop indicates a velocity of 3,500 ft. per min., as determined from a representative chart of flow, and is equal to 1,200 lb. of steam per hour.

There are many other possible applications of this method, for example; finding flow of steam for determining sizes of separators, traps, etc.; to check steam consumption of equipment roughly; to determine water flow in a branch line; to determine compressed air flow, either in velocity or volume in order to select proper sizes of air separators or to check up on compressor performance.

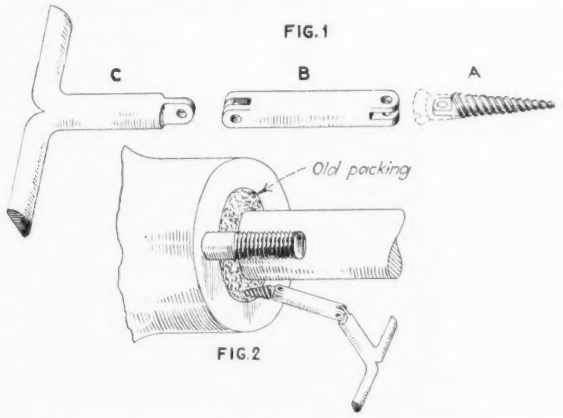
In reading the gages, the greatest care should be taken to observe them from the same angle of vision so that there will be no error due to parallax. Likewise the readings should be taken under maximum flow conditions and with constant flow. If there is any doubt about the constancy of flow, the test should be repeated several times until duplication of results proves the uniformity of flow.

Aside from the better results secured when regulators, separators, and piping of correct size are selected, the saving in first cost will often well repay the trouble involved in making tests to determine flow in the line.

New York, N. Y. CHARLES C. PHELPS

Simple Universal-Jointed Packing Screw

HERE is a simple yet effective little universal-jointed packing screw that may save a lot of cussing on some hard-to-get packing on pumps or piston-rod packing boxes. It is made from a coarse-thread large-size wood screw and a couple of pieces of cold-rolled round rod

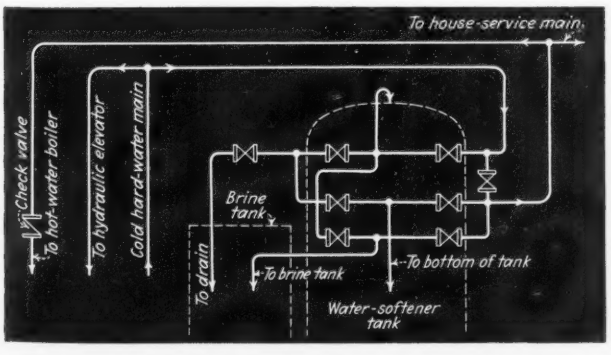


about the same diameter as the body of the screw used. Two flat sides are filed on the screw head as at *A* in the diagram, Fig. 1. A shank as at *B*, slotted and drilled for a tee handle as at *C*, is made by sawing, splitting and bending. The pieces put together with pins complete the tool, shown in Fig. 2.

Penacook, N. H. CHAS. H. WILLEY

Hydraulic Elevator Causes Trouble in Drinking-Water System

AFTER a Zeolite water softener was installed in our plant, we had considerable trouble with bad-tasting water in the service line. At first it was thought that we did not back-wash the softener frequently enough. It was found, however, that no amount of back-washing would prevent bad-tasting water occasionally. A search for the trouble revealed that a hydraulic elevator caused the trouble.



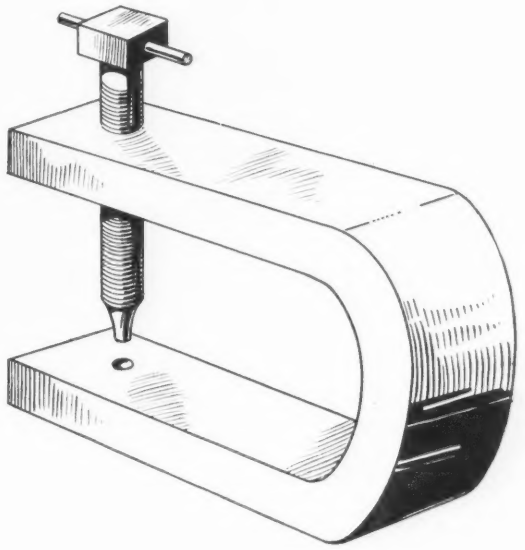
Connections to hot-water boiler, hydraulic elevator and water softener are shown in the diagram. The main cold-water line connects elevator and softener. From the softener, lines run to a hot-water boiler and to the building services. It was found that when the elevator was operating in the up-direction that it causes about 20 lb. drop in the water-main pressure. Under this condition water would flow from that hot-water boiler, back through water softener and to the elevator. When this happened some of the water from the hot-water boiler got into the drinking water mains and caused the bad taste complained about. The trouble was eliminated by installing a check valve, as shown, in the feed line to the hot-water boiler.

Monrovia, Calif. R. L. PARKER

Handy Sheet-Metal Punch

THE punch shown in the figure was made to punch holes in spring steel for making mechanical movement springs that were difficult to obtain from the machine factory. Afterwards I found it an indispensable tool for sheet-metal rivet-hole punching, and it is a handy tool to have in any tool kit.

The frame of the punch is a U-forging made of $\frac{3}{4}$-in. steel stock. I have three sizes of these punches, $\frac{1}{16}$, $\frac{1}{8}$ and $\frac{3}{16}$ in. These I made out of cap-screws, turned down on the end to size and case-hardened by heating to a cherry red, then giving a liberal saturation of cya-



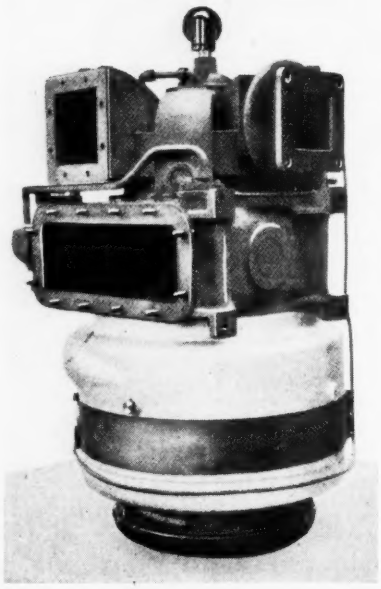
nide. Such a punch stands up well to the work. The hole in which the punch end enters should be $\frac{3}{16}$ in. oversize to allow clearance, and this hole should be bored after the punch has been threaded through as this gives the correct line-up.

Chicago, Ill. R. C. BROWN

ARMATURE COIL SHORT CIRCUIT—A short circuit in an armature coil causes it to overheat and burn out. A short-circuit in a field coil may cause the other field coils to burn out. Therefore, if a field coil roasts out it is not enough to rewind this coil; the fault in the apparently good coils must be located and repaired.

CURRENT COMMENT

Superchargers or Another Diesel



Exhaust blower set suitable for 500-b.hp. engine, 4 ft. high, maximum diameter 2ft. 2in., weight 0.48 tons

IN SEPTEMBER, 1934, *Power*, page 518, was this question: "We have two 500-b.hp. 4-cycle diesels in a plant 5,000 ft. above sea level. Recently load has increased and we would like to increase plant peak capacity to about 1,200 b.hp. Is it preferable to add another engine, or would superchargers be more economical?"

In my opinion the questioner should fit an exhaust-gas turbine-driven pressure charging blower to one of his diesels, as only in this way will he obtain necessary output of the engine with lowest cost and highest efficiency.

Engine output at 5,000 ft. altitude amounts to 500 b.hp. per engine. The normal sea-level rating will be 600 b.hp. with an m.e.p. of about 78 lb. per sq.in. If pressure charged according to the Buechi system with an exhaust gas driven Brown Boveri turbo-blower, the diesel output can be increased (at sea-level) up to 900 b.hp. continuously; neither exhaust temperature nor heat carried away in the cooling water being in this case higher than in a normal non-pressure-charged engine of 600 b.hp. at sea level. At higher altitudes, the output of 900 b.hp. with pressure charging can be maintained, provided that the air conditions at the inlet valves and the back-pressure at the exhaust valves remain unchanged. The engine "would not even notice" that it had been installed in a high altitude, as the exhaust turbine-driven charging blower preserves sea-level conditions at the valves.

When compressing atmospheric air to sea-level pressure, at a given altitude, the increase in air temperature is larger than the normal differences in temperature between sea-level and high-altitude air conditions. For this reason a slight drop in output will always occur. At 5,000 ft. height this drop would amount to 8 per cent.

In the case of an existing engine to be converted to exhaust-pressure charging, it is advisable to rate the engine somewhat cautiously. The questioner only needs 700 b.hp., while the engine, if new, could give 825 b.hp. (at 5,000 ft.). This leaves a safety margin of 16 per cent, as compared to the usual practice for new engines. With one engine giving 700 b.hp. and the other 500 b.hp., the increase in plant load will be taken care of easily, even for continuous operation. For future expansion, another 200 b.hp. is available by converting the second engine.

The Buechi system for exhaust pressure charging uses the exhaust gases in a waste-heat turbine. The turbine drives a blower connected to the suction air main of the diesel. Energy for driving the blower is thus obtained at no cost—caloric energy that is otherwise lost with the exhaust—whereas other systems with blowers driven by chain or belt from the engine shaft or by an electric motor of any type have to consider constant operating costs for supplying the necessary energy. This current expense will in a comparatively short time compensate for whatever differences may exist in the costs of installing one or the other blower set. (Most of the answers to the above queston in the November number of *Power* fail to recognize this fundamental difference in existing supercharging systems and therefore reach conclusions which do not apply to exhaust pressure charging.)

For the normal load of the diesel charging air pressure surpasses back pressure before the turbine, so that by leaving inlet and exhaust valves of a cylinder open simultaneously, the pre-compressed air blows right through the cylinder, thus cooling all hot parts around the combustion space. This scavenging effect is largely obtained by subdivision of the exhaust pipe in such a way that a pressure variation is built up in the exhaust pipes reaching lowest pressure near top dead centers where scavenging of those cylinders exhausting into the same main takes place. In this way the weight of the scavenging air can reach 25-30 per cent of combustion air weight, so that the cooling effect is considerable. The compression space is, due to the above-mentioned scavenging, always filled with fresh air, thus increasing the air weight in the cylinder. Combustion itself is improved by scavenging of the cylinder, as the hot residual gas in the compression space of normal engines is expelled in exhaust turbocharged diesels, thus no longer spoils the pureness of the fresh air charge.

By exhaust-pressure charging, several other advantages are obtained: small amount of heat carried away in the cooling water (small recooling plant), high overload margin (for the engine concerned 15-18 per cent) and constant low fuel consumption over a large range of outputs, small lubricating oil consumption, long life of exhaust valves, cylinder heads, piston crowns and cylinder liners due to the cooling effect of the scavenging air, etc.

Especially for diesels at high altitudes the saving in fuel consumption is not to be neglected. A normal (non pressure-charged) diesel would run at 5,000 ft. on a load of 82 per cent of the sea-level rating. The mean load in a power plant will not be higher than about 80 per cent of the full load, i.e., in a 5,000 ft. altitude 65 per cent of sea-level rating. The exhaust pressure-charged engine, however, when running with 80 per cent of the rated charge at 5,000 ft. ($0.8 \times 700 = 560$ b.hp.) reaches practically the full-load sea-level rating of the non-pressure-charged engine. Consumption with this load will be slightly less than that of the latter engine at full load, due to the air purifying effect of cylinder scavenging.

Conversion to exhaust pressure charging always involves some minor alterations in the diesel, mainly in valve gear, exhaust pipes and fuel pumps.

New York, N. Y. PAUL R. SIDLER
Representative,
Brown Boveri & Co., Ltd.

Another Solution

PRINCIPAL points to be considered are:

1. Effect of altitude on power output.
2. Power output of the two engines at the present time.
3. Power to be expected from the 500-hp. engines when naturally aspirated.
4. Power available from a supercharged engine.
5. Factors involved in selection of an engine.
6. Load factor of the plant.
7. Relevant cases.
8. Supercharger capacity required for two and three engines.

Due to the reduction in atmospheric density, the power which a given diesel can develop decreases with increase of altitude above sea level. Engine horsepower is limited by (1) lack of sufficient oxygen to burn the fuel and (2) by the inability of the engine to get rid of its exhaust heat. Generally speaking, the indicated horsepower of the engine may be said to vary directly as the atmospheric pressure, assuming temperature to remain unchanged. Brake horsepower does not vary exactly as the pressure because the friction horsepower is nearly constant at all altitudes. If we assume a mechanical efficiency of 80 per cent for this problem, the engines may be now developing 86 per cent of their full power rating at 5,000 ft., when naturally aspirated. In other words, the two engines which are rated 1,000 hp. at sea level (if this rating is nearly correct), will only develop 860 hp. at 5,000 ft. when naturally aspirated. In this connection I may say that some engines are under-rated at sea level and thus will give their rated capacity at altitudes as high as 5,000 ft.

If an additional engine with a sea level rating of 500 hp. is bought, it may be expected to give in the neighborhood of 430 hp. at 5,000 ft. The three engines when combined, with natural aspiration, would give approximately 1,290 hp., which, when compared to the peak of 1,200 hp. desired is rather a small margin.

When an engine is supercharged at sea level, an increase of power ranging from 33 to 35 per cent may be expected. In order to gain the same increase at 5,000 ft. it would be necessary to make up the difference of pressure between sea level and the pressure at 5,000 ft. and in addition add about 5 lb. more. Generally land installation engines are not designed with such narrow margins of safety that they will not stand the extra load imposed by an increase of power of 35 per cent.

General principles to be considered in selecting a diesel are:

1. Engines usually operate with the best fuel economy between half and full load.
2. A small diesel is as efficient as a large one.
3. The overload capacity of a diesel should not be counted upon to handle regularly recurring peak loads.
4. It is always possible to augment the plant with additional engines.

Three-quarter load is considered the best operating point for a diesel. Load factor should be considered in this problem, and loads on the engines arranged so that at all times the engine or engines is running at as nearly three-quarter load as possible.

Just recently I witnessed the change of two air-injection, 4-cycle, naturally aspirated engines to supercharged engines. This change was made in order to increase the power as much as possible. The characteristics of these engines were: 8-cyl., 12 x 14-in., 380 r.p.m., 600 b.hp. (rated), 810 b.hp. net after supercharging, 5 lb. supercharger rating, sea level.

The supercharger supplied was a Roots type with two lobes and was driven by a Vee belt from the main crankshaft. The engines performed very well. No change had to be made in timing. There was a tendency for exhaust temperatures to exceed those which had obtained when the engines were naturally aspirated. However, the valves were not cooled and did not show any signs of this extra heat.

In order to supercharge a 500-hp. diesel, a blower of approximately 1,600 cu.ft. per min. capacity would be required. When producing this 1,600 cu.ft. the blower would absorb approximately 50 hp. when operating at a difference of pressure between inlet and outlet of about 7 lb. per sq.in.

The two engines could be expected to develop power as follows:

Supercharged to sea-level pressure:	
Output	1,000 b.hp.
Blower Power	60 b.hp.
Net	940 b.hp.
Supercharged to 5 lb. pressure above sea level:	
Output	1,330 b.hp.
Blower Power	100 b.hp.
Net	1,230 b.hp.

If a third engine should be bought, the three engines could be expected to develop power as follows:

Supercharged to sea-level pressure:	
Output	1,500 b.hp.
Blower Power	90 b.hp.
	1,410 b.hp.
Supercharged to 5 lb. above sea-level pressure	
Output	1,995 b.hp.
Blower Power	150 b.hp.
	1,845 b.hp.

No change in fuel consumption per horsepower-hour could be expected. It might be necessary to put a valve in the exhaust line in order to choke it down to obtain atmospheric pressure at sea level.

Under present load conditions a supercharger separately driven and capable of supplying 3,600 cu.ft. of air per min. at 8 lb. per sq.in. would be profitable and practicable.

However in view of the recent increase in load demand it might be expected that another increase might come in the near future, in which case the purchase of a third engine together with a supercharger capable of supplying all engines would be in order.

This discussion can only be general because it is not known what make of engines are installed. And further, in order to tell definitely the size of blower it would be necessary to know the dimensions of the engine as well as its characteristics.

Therefore I would suggest that before any actual work of converting the engines is begun, the problem of the correct size of supercharger be put up to the manufacturers of the engines and their reaction to the change obtained.

Groton, Conn. C. J. CATER
Navy Dept., Bureau of Engrg.
Office of Inspector of Machry.
Electric Boat Co.

READERS' PROBLEMS

QUESTIONS for Our Readers

DETERIORATION OF RUBBER COVERED WIRE

Question 1

IT IS *understood that after a number of years rubber insulation will deteriorate dangerously. Some of our circuits that are in iron conduit in dry locations have been in service for 25 years, and although no failures have yet occurred the question of replacing these old circuits while prices are low is before us. Ours is an industrial plant and the motors have operated 8 hr. daily. Room temperatures are normal. The areas of the conductors conform to present day N.E.C. requirements. We would like to know the life expectancy for both rubber and varnished-cambric insulation, also what tests should be made to determine whether or not these old circuits should be replaced. We find that many old splices have been insulated with varnished cambric instead of rubber tape. Is this permitted by the N.E.C. and if not, are the varnished cambric insulated joints likely to give trouble?* —R. B. G.

WHERE TO PUT BRINE PUMP

Question 2

IT IS *generally customary to install the brine circulating pump ahead of the brine cooler. In a brine system we contemplate installing the brine receiver or surge tank is located about 30 ft. above our shell and tube brine cooler. Plant conditions make it more convenient to install the circulating pump with its suction connected to the cooler instead of the warm brine return. Are any troubles likely to develop because of this location and if so what will they be?*

Suitable answers to these questions from readers will be paid for if space is available for their publication.

Why Not Put the Pump at the Spring?

A PUMP *to deliver 50 gal. per min. is to be located 1,400 ft. from a spring and will have a static suction lift of 14 ft. We have a lot of 2½-in. pipe in stock and would like to use some of it for a suction pipe on this pump. Can this pipe be used? What type of pump will be the most efficient for this service?*—F.M.D.

You cannot use the 2½-in. pipe for the pump suction line because of excessive friction loss. With 50 gal. per min. flowing through a 2½-in. pipe, the velocity will be 3.27 ft. per sec., and the friction loss will be the equivalent of 3.32 ft. head per 100 ft. of straight pipe. Therefore, in 1,400 ft. of pipe, the total friction loss is the equivalent of $3.32 \times 14 = 46.48$ ft. head. This is more than double the suction head that the pump should operate against for satisfactory service and it does not take into account the elbows or valves that may be in the line. Each of these will cause a friction loss that is equivalent to about 11 ft. of straight pipe.

The smallest pipe that you can use in the suction line is 4 in. This has a friction loss per 100 ft. of 0.34 ft. head or a total of about 5 ft., which, with the static lift and losses in the elbows, will bring the suction lift up to around 20 ft. Under normal conditions this would be satisfactory, but where the suction line is 1,400 ft. long the problem should be very carefully considered. Before going ahead with this project you should consult with the pump manufacturer's engineers and get their recommendation. When you purchase the equipment be sure to get a guarantee that the pump will operate under the conditions for which it is sold.

Your problem is not one of which pump is the most efficient or which will operate with the lowest cost, but one of getting a pump that will operate satisfactorily under the very severe conditions that exist. A self-priming centrifugal pump will probably be the most satisfactory. If it is possible to do so, the pump should be located at the spring, then almost any type of pump may be used, and it may be economical to use the 2½-in. pipe in the discharge line, of course making proper allowance for the increase in dynamic head because of this pipe.

How Should the Coils Be Grouped in a Winding?

HOW *should 48 coils be grouped in an induction motor to give a balanced three-phase six-pole winding? Such a winding has 18 pole-phase groups, which, for an even number of coils in each group, requires some multiple of 18, such as 36, 54, 72 or 90 coils. With 48 coils in the winding, a suggested grouping would be 3-3-2, 3-3-2, 3-3-2, etc. Although this arrangement gives an equal number of coils in each combination of three pole-phase groups, all the two-coil pole-phase groups fall in the same phase. What arrangement should be used?*—A.C.

A situation of this kind may be taken care of by shifting the position of the two-coil pole-phase group in successive combinations of three pole-phase groups. For example, the combinations may be 3-3-2, 3-2-3, 2-3-3, 3-3-2, 3-2-3, 2-3-3. While these combinations do not give an entirely symmetrical arrangement, they make a correct practical working connection. The winding may be connected either in series or parallel, star or delta according to standard, six-pole, three-phase diagrams.

Effect of Clearance on Air-Compressor Performance

WHAT *effect has cylinder clearance on the capacity and power required by an air compressor?*—K.A.A.

In single-stage compressors, cylinder clearance reduces the volumetric efficiency, or ratio of the volume of free air admitted and compressed in the cylinder, to the volume of piston displacement. The per cent of capacity reduction is greater than the per cent of cylinder clearance. This is because the piston must travel back part of the return stroke before the clearance-space air has expanded to atmospheric pressure, permitting free air to flow into the cylinder. The volume occupied by the expanded clearance air increases as the pressure increases, therefore the loss in compressor capacity is proportional to its discharge pressure.

Loss of volumetric efficiency due to clearance is less for two-stage than for single-stage compression, volume and terminal pressure being equal. For a given capacity, the low-pressure cylinder of a two-stage compressor is practically the same size and has the same per cent clearance as that of a single-stage compressor. The difference between intake and discharge pressure for the two-stage machine is much less than for a single-stage unit, with less expansion of compressed clearance-volume air back into the cylinder.

The work required for compressing the clearance air to receiver pressure helps to move the piston on the return stroke, when the air expands back to intake pressure. As the loss of heat during expansion is practically negligible, the loss of power due to clearance is small. An increase in clearance, however, increases the size of the compressor for a given capacity, thereby requiring more power to drive it.

Leveling and Landing

WHAT *is the difference between an automatic-leveling and an automatic-landing type elevator?*—F.B.

An automatic-leveling elevator is one that will automatically level into a floor when making a stop. For example, assume that the car when on up motion stopped 3 in. above the floor. The control is so arranged that the car will automatically start down and come level with the landing floor. The automatic-landing-type elevator stops the car level with the floor. If the control happens to get out of adjustment and the car stops 3 in. away from the floor, the control will not level it into the landing as would a self-leveling-type equipment. The trouble can only be corrected by adjusting the control. Both types are used extensively for high-speed passenger elevator service.

WHAT CAUSES KNOCK IN COMPRESSOR

Answers to November Question 1

THE QUESTION

WE HAVE *two compressors, a 45-ton and a 60-ton, which heretofore operated at head pressures of 125 to 150 lb. Now, due to the cutting in of lines and the adding of new coils that have increased refrigerating surfaces about 40 per cent, they operate at head pressures of between 175 and 225 lb. Excess air in the system cannot be purged out every day because the lines have to be opened in the morning and put back into operation in the afternoon for production.*

Up to the time of the recent change the compressors ran very smoothly, but since the change was made they have developed a decided knock, which has all the indications of that caused by a wet gas when it is coming back and freezing over. However, there is no visible evidence that it is coming back. The compressors do not frost over. The suction pressure is quite normal, 22 to 25 lb.

My first thought was that the compressors were laboring due to overload caused by the added amount of refrigeration they now have to carry. However, cutting out these new additions by closing the expansion valves and putting on only those which have not been changed so far (insofar as capacity is concerned) does not alleviate the trouble. The knock does not seem to be a mechanical defect because the compressor will run, continuously knocking, for ten or fifteen minutes, and then suddenly stop knocking and run just as smoothly as before for a few minutes, and then again begin to knock. This leads me to believe that somehow the wet liquid is slugging back. It has been suggested that to remedy this condition (due to the increase in refrigerating surface) the suction lines will have to be increased. Will you tell me what might be the cause of the trouble and how it can be corrected?

—M. S.

Install Thermometers To Check Suction Gas

IT IS odd that both compressors would develop knocks at the same time unless this new condition had something to do with it. It is also rather odd that this new condition could cause these knocks.

The first and best thing to do is get enough thermometers for both compressors and make sure about the condition of your suction gas. If your gas is coming over at intermittent periods wet enough to cause these knocks and you cannot at once enlarge your suction lines enough to cut down your gas speed to where it will not bring this liquor over, then you should cut down on the amount of liquid carried on the suction side until these knocks disappear, put in an oversize liquid trap, then later put in pipe to fit your new condition.

I do not see how you can increase the amount of refrigeration 40 per cent and your head pressure go up 25 to 75 lb. and have a normal suction pressure unless you have a steam plant. If you have this, extra speed and head pressure has caused your trouble. With two constant-speed machines, to increase your refrigeration you would have to increase your suction pressure, and this will boost your head pressure about two for one if neither condenser nor cooling water is changed.

With this increase in suction and discharge pressure the discharge gas temperature will increase. This higher gas temperature might cause your rod adjustments to be wrong for this new condition. Rods set real close, the crank pin bearings a little loose and the suction line not large enough to supply both compressors with gas all the time, are three conditions that could cause your intermittent knock and can be stopped by a new piston clearance adjustment. If your suction lines are this small you will very likely have a suction valve noise that you do not hear now because of the piston knock.

You can easily set a compressor so that the piston will knock when the suction valve is closed or nearly closed. You can check this insufficiency of gas theory by running each compressor alone for a little while and if the compressor does quiet down it will mean that both compressors need readjusting for this extra heat and pressure and that you should certainly increase your suction piping as soon as possible. When you cut back on your refrigeration load as stated you perhaps did not allow your rods time to change their length because of the heat difference, therefore your test could not affect either machine much.

You should have the thermometers in use any way, so I suggest that you equip both compressors with them and make sure about the condition of the gas. If your gas is as it should be, then shut down the large compressor and if the small compressor quiets down it will mean that you will have to readjust both compressors and change your suction line.

If none of these suggestions straighten you out then you have two badly overloaded machines and might as well look for bearing trouble or noise soon.

Clarksville, Tenn. ZANZIE EDWARDS

Valves Cause Compressor Noise

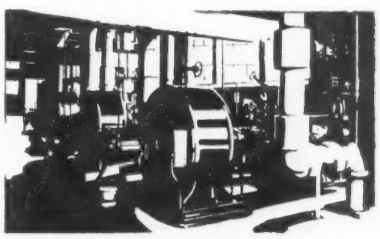
M. S. IN his description of his compressor trouble, does not tell of the refrigerant used or the type and speed of the machines or the drives, which could enter into an analysis of the trouble. The pressures mentioned and other details lead one to believe that the system is a hand-operated, direct-expansion ammonia plant, and, if the machines are of a twin-cylinder, vertical, single-action type with poppet valves, the following may be a way to a solution.

Machines of this type often become noisy when laboring under extreme pressure differences between suction and discharge sides due to valves slamming shut at reversal of strokes. In the V.S.A. type of compressor the suction valve of the poppet type, is in the piston head and is slightly spring loaded and also cushioned by a dash pot (or gag) and under normal operating conditions virtually floats in the guide during the up and down strokes. Under the imposition of the additional up to 100 lb. pressure added to the discharge side, the valve might esaily slam closed with violence upon reversal of stroke at bottom dead center, especially so if the dash pot cylinder and piston of the suction valve assembly are slightly worn.

The discharge valve will slam closed noisily under the impetus of the added pressure on top of the valve coupled with the increased tension of the discharge valve spring on reversal of stroke on top dead center. Several cases have occurred where the safety head lifted repeatedly, due to cylinder pressure overcoming the spring tension in bucking the high side pressure. This causes a particularly distinct and severe knock.

M. S. writes that the suction pressure is normal at from 22 to 25 lb. If this is so and the compressors have not been speeded up, the refrigerating capacity has not increased, but has actually decreased, as the following will show.

The volumetric efficiency of ammonia compressors changes with the pressure ratio between absolute suction and absolute discharge pressures. The volumetric efficiency of medium speed machines will drop from 87¾ per cent at 25 lb. and 125 lb. gage pressures to 82¾ per cent at 25 and 225 lb. gage pressures and the machine capacity will drop 13.8 per cent. In addition to this loss the horsepower per ton of refrigeration will increase 73.5 per cent as the actual



indicated horsepower per ton at 25 lb. and 125 lb. is .83 hp. and at 25 lb. and 225 lb. is 1.44 hp. The pressures in the illustration are the extremes, mentioned by M. S., to point out what is possible.

Evidently the plant is not graced with a non-condensible gas purger which a plant of that size warrants. The excess head pressure, providing water temperatures and condensing surface are the same as before, is due to carelessness or ignorance in cutting in the additional evaporating surface. Not the cheapest but the easiest and quickest way to rid a system of much foul gas is to pump back the system, till the receiver is full, shut down the machine, close the discharge valve at the machine, close the liquid drain line valve from the condenser at the receiver, and open a valve, discreetly on the condensing system at some point between the two above-mentioned valves and blow down to atmospheric pressure or a little above. While this system is wasteful of ammonia it is a real purge, and the saving in power will overcome the cost of the lost ammonia in a short time. A method used with success was to pipe a line from the purge valve at top of the condenser to the sewer drain and run a stream of water down the sewer at the time of purging, this prevents objectionable odors.

San Francisco, Calif. RAY B. WOLF

Too Much Ammonia May Cause Trouble

INCREASING your cooling surface 40 per cent. resulted in an operating condition of near-freezing back and a 50 lb. increase of head pressure. How much ammonia did you add to your charge when you increased your cooling surface? Your operating faults may be caused by too much ammonia in your system.

If your system is properly designed you do not need to increase your suction lines. Install a pre-cooler in suction line which will eliminate a large amount of liquor which is slugging back to compressor and at the same time increase plant efficiency.

You can install a purger over your receiver which will function while your plant is in operation. It will take care of the air in your system and eliminate breaking lines for the purpose of purging.

Newark, N. J. FRED STROK

WHAT ABOUT CONDENSER TUBE SCALE?

Answers to November Question 2

THE QUESTION

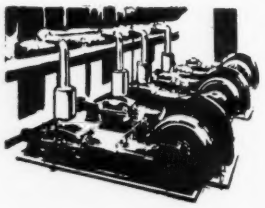
WE ARE *making a study of scale deposits in the tubes of surface condensers. The question has arisen as to whether or not serious trouble with scale has been encountered where an adequate supply of fresh water (river, lake or well) is available, so that recirculation is not necessary. Water passes once through the condenser and is allowed to go back to the river, and sufficient water is available so that its temperature does not rise more than 10 deg. F. between the inlet and outlet of the condenser.*

I have had considerable experience in the operation of plants using unrecirculated condenser waters from various sources with varying degrees of hardness. I have experienced little difficulty with scale deposits such as is experienced when the water is cooled and recirculated, allowing the natural hardness in the water to concentrate in the spray pond or cooling tower. Experience of readers with this problem would be interesting. If heavy scale deposits have been encountered other than deposits of mud or silt where a continuous supply of fresh water is available, it would be of interest to know what the analysis of the water showed. To satisfy the conditions in mind, the water supply should be sufficient so that there is not an excessive rise in the temperature while passing through the tubes. —N. A. M.

Condenser Scale From Calcium Carbonate

SCALE formation in condensers, where the water passes once and then goes to waste is one of those questions where results vary with conditions. The answer for the majority of cases would be that no scale would form. Yet this is not the safe answer, for there will be many cases where the tubes will scale. Also there is more than one kind of scale.

Let us face the facts. Scale, first of all, is supposed to form from materials that are made insoluble by some condition of operation, and that deposit and adhere to a surface. Most condenser scale is principally calcium carbonate mixed with small amounts of magnesium carbonate, silica, iron and organic matter. Calcium carbonate of lime is really not soluble in water. However, as water passes through the ground it absorbs carbon dioxide, an acid gas byproduct of plant growth. This makes the water acid enough to dissolve any lime stone (calcium carbonate) it may pass over. The solution product is stable as long as the water is cold, or as long as no condition is created to remove the gas from the water; but any force that will remove the gas will make the calcium once more insoluble. Heat is one of those forces. Enough heat properly applied can almost



completely precipitate calcium and magnesium carbonates from the water.

In the condenser the question is whether enough heat can act for a long enough time to do this. If the cooling water is in constant motion, in sufficient volume, and the speed of circulation is sufficiently rapid, no scale should form; but just to the extent that these three conditions are not met will the danger of scale formation develop.

There is another sort of film problem which possibly was not meant to be considered when this question was framed; but which interferes with efficient heat transfer much as does scale, and that is a film of algae or growth from organisms in the water. This rarely, if ever, forms when properly purified city supplies are used, but when the water is taken from an untreated pond, river or surface supply it is something that must be watched for and overcome.

Chicago, Ill. D. K. FRENCH

Surface Water Should Not Scale

SCALE formation from non-recirculated condenser cooling water would not be expected with a surface water supply. However, well waters which are often used for condenser cooling in refrigeration work may produce very troublesome deposits in a single pass through the condenser and with a relatively small temperature change. This happens when the water is highly mineralized with calcium bicarbonate. On contact with the condensing surfaces voluminous deposits of calcium carbonate occur.

Occasionally well water will contain a considerable excess of carbonic acid over the amount required to hold the calcium in solution. This adds the further complication of corrosion. In such cases the condenser deposit is a mixture of calcium carbonate and rust resulting from the action of the carbonic acid on the iron piping.

A well water supply containing approximately 600 parts per million of calcium bicarbonate had also about 200 parts per million of free carbon dioxide and a pH value of 7.0 at the discharge of the well. This represents an unstable condition, and on exposure to air or the pressure and temperature otherwise changed, visible bubbles of carbon dioxide are formed as the gas leaves the solution. After one year's operation before corrective measures were taken a new condenser had to be retubed on account of the severe corrosion which took place under the heavy muddy deposit of calcium carbonate and rust.

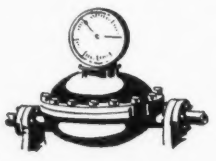
Springfield, Ill. K. M. HOLADAY

POWER'S HISTORY

POWER was founded in 1884 by E. P. Harris and H. M. Swetland. With it was incorporated *Steam*, which had been started by N. Hawkins in Chicago two years earlier.

In 1903 *Power* purchased and absorbed *Science and Industry*, which was a consolidation of a number of periodicals, namely, *Home Study Magazine, Home Study for Machinists, Mechanic's Magazine, Home Study for Building Trades, Building Trades Magazine, Home Study for Electrical Workers* and *Steam Electric Magazine*.

In 1908 it absorbed *The Engineer's Review*, of Cleveland, and *The Engineer*, of Chicago, the latter being: consolidation of *The Safety Valve, Lord's Power and Machinery Magazine, The Stationary Engineer, Engineers and Power Users Magazine, Steam Engineering* and *The Mechanical Engineer*. When *The Engineer* was



purchased the name of the combined paper was *Power and The Engineer*. The title was condensed to *Power* in 1911.

Ownership of *Power* passed from E. P. Harris to H. M. Swetland and James H. McGraw, then to John A. Hill; and with the consolidation of the Hill Publishing Company and the McGraw Publishing Company, in 1917, it became the property of the McGraw-Hill Publishing Company.

Robert Grimshaw was the first editor of *Power*. Subsequent editors for short periods were George L. Fowler, A. D. Risteen and Franklin Van Winkle. F. R. Low was editor from 1888 until Dec. 31, 1929. Ely C. Hutchinson was editor from Jan. 1, 1930, to Feb. 1, 1933.

The present staff consists of P. W. Swain, editor; F. R. Low, editor emeritus; F. A. Annett, R. B. Purdy and E. J. Tangerman, editorial staff.

THE ENGINEER'S BOOKSHELF

A. C. Engineering

ELECTRICAL ENGINEERING—VOL. II—ALTERNATING CURRENTS (3RD EDITION)—*By Chester L. Dawes, associate professor of electrical engineering, Harvard Engineering School. Published by McGraw-Hill Book Co., Inc., 330 West 42nd St., New York, N. Y. Clothboard covers. 705 pages, 5½x8 in. 477 illustrations. Price, $4.*

Unlike most college texts on alternating current, this one is elementary in character and is intended as a stepping stone to more advanced work. The first two chapters are devoted to fundamental laws of alternating-current circuits. Subsequent chapters consider the application of these fundamentals to alternating-current measurements, polyphase circuits, alternating-current machinery, and to power transmission.

Treatment has been revised and enlarged to conform with modern practice. The chapter on vacuum tubes has been expanded to include later types of tubes such as tetrodes and pentodes and their applications. A new chapter has been added on rectifiers and the one on photometry has been removed. Other chapters have been revised to include the developments in high-starting-torque low-slip induction motors, the double-spirrel-cage motor, high-starting-torque synchronous motors, synchronous motors for timing purposes, and capacitor motors. A more extensive analysis of machine principles has been included and an entirely new set of problems has replaced that of the second edition. Problems relating to electrical-engineering applications have been chosen with special reference to present practice. The practical and elementary treatment of the text makes it suitable to a wide range of readers.

Hydro Engineering

WATER-POWER ENGINEERING (2nd EDITION)—*By H. K. Barrows, professor of hydraulic engineering, Massachusetts Institute of Technology. Published by McGraw-Hill Book Co., Inc., New York, N. Y. Clothboard covers. 762 pages, 6x9 in. 125 tables; 311 illustrations. Price, $6.*

The first edition of this book was published in 1927. Since then important progress has been made in hydro-electric engineering and this edition has been produced to bring the book up-to-date. It follows very closely the arrangement of the old edition, is slightly enlarged, retaining the original chapter headings, which are:

Water power development—its distribution and use; hydrology; the study of stream-flow data and water-power estimates; hydraulic turbines and general arrangement of plant; the dam; the waterway—canals and penstocks; power house and equipment—hydraulic and structural; power house—electrical; plant accessories; speed and pressure regulation; transmission lines; cost and value of water power; reports and plant descriptions; hydraulic development outline.

The chief changes in the text have been made in the chapter on "Cost and Value of Water Power," which has been rewritten to bring it in line with modern economic conceptions of the value of water-power projects. The table, "Data on Large Hydro-Electric Developments," which gives data on 67 items in hydro-plant design, in Chapter VII, has had data on 21 new plants added, bringing the total to 69. Group I problems at the end of the book are largely new and of greater scope. Other new material has been added to increase the number of pages by 28 over those in the old edition.

Chemistry Handbook

HANDBOOK OF CHEMISTRY & PHYSICS (19TH EDITION)—*By Charles D. Hodgmans. Published by Chemical Rubber Publishing Co., Cleveland, Ohio. Semi-flexible imitation leather binding, 4½x7 in. 1934 pages, gold edges, round corners. Price $6.*

As a reference handbook this deserves the very highest praise. In binding, size and general appearance, it resembles the standard mechanical engineering handbooks of Marks and Kent. The title may lead the average power engineer to expect that the contents are entirely out of his field. This is far from true. More and more the power engineer is confronted by applications of physics and chemistry. He will find here the answers to hundreds of every-day questions that concern his job.

The "Handbook of Chemistry and Physics" contains 274 pages of mathematical tables and formulas; 956 pages of chemical tables; 44 pages on properties of matter; 146 pages on heat; 114 pages on sound, electricity and magnetism; 70 pages on light; 283 pages on measures and units.

Among the many items of value to power readers are the tables and charts covering annuities and sinking funds, density of moist air, thermodynamic properties, resistance of wires, melting and boiling points of the elements, common names of chemicals, atomic and molecular weights, solubilities, heats of combustion, etc.

Chemistry

HANDBOOK OF CHEMISTRY (1934)—*Compiled and edited by Norbert A. Lange, Ph.D., Case School of Applied Science. Published by Handbook Publishers, Inc., Sandusky, Ohio. 1545 pages, 5½x7¾ in. Fabrikoid covers. 29-page index. Appendix with 248 pages of mathematical tables and formulas. Price, $6.*

Chemical and physical data for reference—this is the story of this handbook. Everything from antidotes for poisons to the Greek alphabet is included. Power engineers will find particular use for tables of physical and chemical properties of various materials, common and trade names of chemicals, water analysis, chemicals for treating water, drinking water standards, formulas for water softening, composition and heating value of representative coals, heat of combustion of coal from analyses, and some dozens of similar data tables on all conceivable chemical and physical data.

BRIEF REVIEWS

A SURVEY OF THE AIR POLLUTION PROBLEM OF THE CITY OF SCRANTON AND LACKAWANNA COUNTY (1934). *Conducted by the Mellon Institute of Industrial Research, University of Pittsburgh, H. B. Meller and Logan B. Sisson.*—This is a reprint of an article in *The Scranton Republican* of Aug. 17, 1934. It runs to 43 pages, 6x9 in. Copies available from The Mellon Institute, Pittsburgh, Pa.

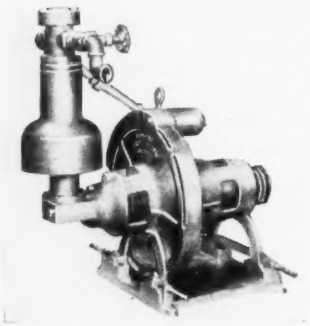
RIVETING AND ARC WELDING IN SHIP CONSTRUCTION (1934). *By Comdr. H. E. Rossell (C), U.S.N., professor of naval construction, M.I.T. Published by Simmons-Boardman Publishing Co., 30 Church St., New York, N. Y. 210 pages, 6x7½ in. Cloth covers. 46 illustrations. Indexed. Price $2.25.*—Although written specially for ship draftsmen, naval architects and students, there are many general principles that can also be applied in welding and riveting of equipment for land use. 77 pages are devoted to riveting, in three chapters: Oil Tightness and Water Tightness in Riveting Work, Design of Riveted Joints, and Riveting Practice — General Features. 133 pages are devoted to arc welding, in two chapters: Design of Welded Joints, Special Design Problems. In each chapter are many subdivisions covering basic principles, theory, practice, faults, inspection, etc.

DAMPFKESSEL - SPEISEPUMPEN (BOILER-FEED PUMPS). *By Ing. Karl Grun. Published by Verlag von Julius Springer, Wien, Germany, 1934. Price 7.50 marks.*—This book, written in Germany, may be of interest to a limited number of engineers who can read the language and are concerned with the problems discussed. It covers the capacities, design, drive and operation of boiler-feed pumps. As German books go, it is only moderately theoretical. It is illustrated by many drawings of pumps and regulating devices.

REFRACTORIES. *Three technical bulletins of American Refractories Institute, available from S. M. Phelps, Refractories Fellowship, Mellon Institute, Pittsburgh, Pa. Free.*—"Action of Gas Atmospheres on Refractory Materials," by S. M. Phelps (10 pages), Bulletin No. 48. "Permeability of Refractory Materials to Gases," (8 pages), Bulletin No. 49. "Application of Insulating Refractories to Industrial Refractories," by J. D. Keller (8 pages), Bulletin No. 53.

COAL—*Detailed Statistics. By W. H. Young, L. Mann, H. L. Bennit and F. G. Tryon. A statistical appendix to Minerals Yearbook, published by U. S. Department of Commerce, Bureau of Mines. Pages 373-454. For sale by Superintendent of Documents, Washington, D. C., 10 cents.*—Production and associated statistics.

WHAT'S NEW IN PLANT EQUIPMENT



AUXILIARY STEAM TURBINE

TROJAN turbine, originally developed to drive oil-field mud screens, can be used with generators for services requiring up to 3½ hp. Newly designed governor does not come in contact with steam. Bearings designed for high-speed operation. One-piece rotor. Unit complete with baseplate upon which can be direct-connected any standard generator or pump. Wt. complete, 275 lb. Bulletin.

California Bettis Co., 1900 East 65th St., Los Angeles, Calif.

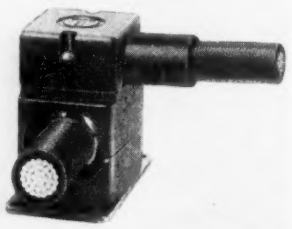
HUMIDITY CONTROL SYSTEM

CALORIDER system has two distinct functions, control of effective temperature and air purity for comfort, or control of humidity and air purity for industrial applications, including drying and purification of gases. Automatic humidistat control. Only power required is for two ¼-hp. motors. In winter, air to be conditioned is drawn several times over trays containing liquid Caloride and through wide cascades of solution pouring over lips at alternating opposite ends of trays. Caloride circulated by centrifugal pump, and smaller gear pump forces spent liquid and water to sewer or storage tank. Partially dried air then passes over lump Caloride, where R.H. is dropped to 25%, and over cooling coils. For winter, Caloride is replaced by warm water, unit operating when R.H. falls below humidistat setting. Air passes over trays and through cascades, picking up moisture, then is mixed with some dry return air (coming through partly opened secondary air inlet damper) to avoid objectionable saturation. Bulletin No. 1.

Research Corp., Calorider Div., Chrysler Bldg., New York, N. Y.

ANCHOR TAP

HIXLEY anchor tap permits mechanical joining of cable, and in addition provides in itself a cable support, where necessary. Its full floating feature permits flexibility, allowing for entrance of main cables at other than right angles. Provision for



making taps permit the tap cable to run right or left, top or bottom, and in addition two taps may be taken if required. The cable grips are of corrugated surfaces and are gripped by clamping with cap screws. A steel mounting plate is drilled for fastening and supports cable runs where required.

Trumbull Electric Mfg. Co., Plainville, Conn.

SURFACE CONCRETE HARDENER

STONHARD surface hardening treatment for concrete floors is said to penetrate the floor surface and act as a vehicle for a solid that fills and seals the surface pores, eliminating pockets that hold disintegration agents, such as oil and acids. Surface treatment is said to give evidence that a floor so treated will withstand wear 162.5 per cent better than an untreated floor. The treatment can be applied on concrete floor areas without interrupting production.

Stonhard Co., 401 N. Broad St., Philadelphia, Pa.

SINGLE-PIPE BUILT-IN HEATER

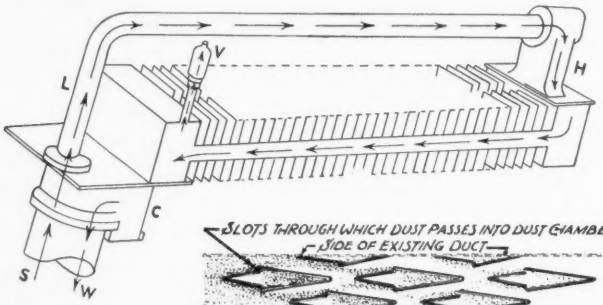
SIMPLEX Convectofin operates on uniflow principle with series-parallel circulation, easy venting and compensation for pressure loss. Steam comes in at *S*, travels up loop *L*, over to heater *H* and enters heater proper. Air and water, if any, are pushed ahead, air being eliminated by air valve *V* condensate through compensator *C* and flows from heater at *W*. Air valve is at extreme end of heater, at low point of circuit. Valve shown installed on a short nipple.

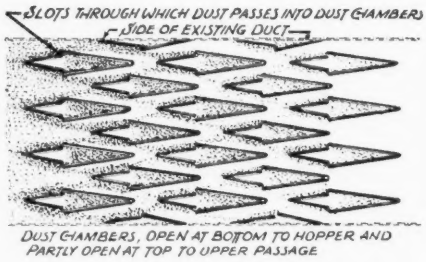
Commodore Heaters Corp., 11 West 42nd St., New York, N.Y.

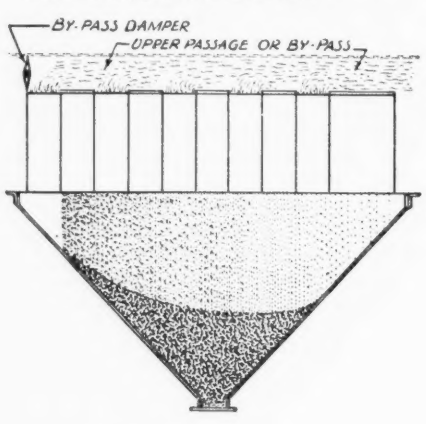
VENTURI TYPE DUST TRAP *(Drawing below)*

THERMIX has low resistance to flow, has good collection efficiency, will occupy space within an existing duct, and is low in cost. Consists of series of venturi-shaped passages through which gas or air passes horizontally. Passages vary in number and extend from bottom of duct to within short distance of top. Gas or air is speeded up as it approaches throats, causing dust particles to be carried by their momentum to the converging walls of each passage, where they concentrate. Dust is thus caught by wall slot, while air passes on to next throat. Retained dust falls by gravity to hopper below. Slight flow of gas or air into slots is led out of bypass at top of each dust chamber, thus avoiding eddy currents. As many as six passages are usually placed along a duct without seriously impeding air flow; more may be used if higher efficiency is required.

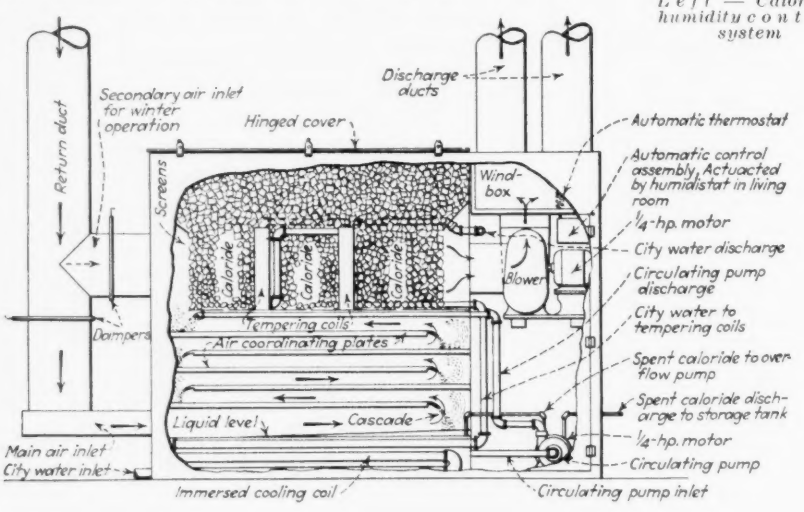
Prat-Daniel Corp., Port Chester, N. Y.

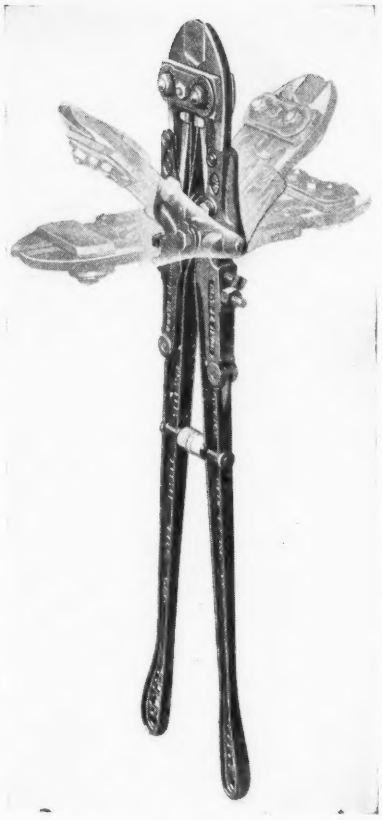



SLOTS THROUGH WHICH DUST PASSES INTO DUST CHAMBERS
SIDE OF EXISTING DUCT
DUST CHAMBERS, OPEN AT BOTTOM TO HOPPER AND PARTLY OPEN AT TOP TO UPPER PASSAGE



Above—Convectofin heater. Right—Thermix dust trap. Left — Calorider humidity control system





SWIVEL-HEAD CUTTER

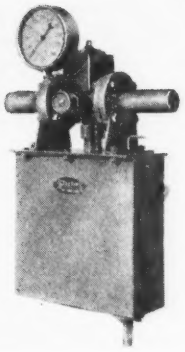
THE HKP Swivel-Head Cutter works equally well up or down, right or left, behind or before, in or out, because the cutting head swivels to any angle on either side of the handles (from nothing to a right angle. A special section joined by a ball and socket joint, with a shoe for holding the cutterhead and a positioning spring to hold the head in the desired position, are all the changes employed. The shoe will hold any standard head of a given size, clipper cut, center cut, chain cutter, nut splitter, etc., and the change from one head to another can be made in a jiffy and on the job. A kit can also be had by which a standard tool can be made into this swivel type at small expense.

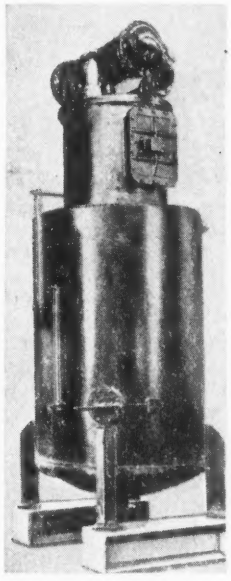
H. K. Porter, Inc., Everett, Mass.

Metal Heat Insulation

FERRO-THERM metal insulation consists of parallel spaced metallic sheets with dull or non-bright surfaces. The sheets have low emission and high reflection values at the frequencies of radiant heat.

Thin sheets of commercial black steel are used and are formed with anguarly arranged surfaces with small ribs at the jointure of these surfaces. Thus, this construction secures rigidity, eliminates vibration and prevents sound waves.





The number of sheets of Ferro-Therm used in an insulated wall may be one or more, depending upon the temperature difference and the heat conductivity desired.

American Flange & Mfg. Co., 26 Broadway, New York, N. Y.

Deaerating Heater

(Photo above)

SPECIAL deaerating heater for use for marine service is designed to remove dissolved gases in the feed water, prevent corrosion in the boilers, feed lines and steam lines, and heat the feed water to the saturated steam temperature. The deaerating element is arranged to allow intimate contact of water and steam and uniform distribution of water, regardless of roll and pitch of ship.

In the heater illustrated the vent condenser is on top and storage tank is vertical. The deaerating heater heads are of the non-storage type, made of cast iron to give maximum resistance to corrosion. Standard material for shell and end heads of the deaerating heater is copper bearing steel or Armco iron. Storage tanks may be arranged vertically or horizontally to meet specific requirements of installation. Support arrangements are welded to the storage tank for any desired type of mounting. Design and construction of equipment meets all requirements of A.S.M.E. Code of Class 2 Unfired Welded Pressure Vessels, as well as requirements of the American Bureau of Shipping and U. S. Shipping Board.

Elliott Co., Jeannette, Pa.

VISCOSITY INDICATOR

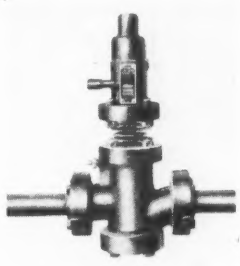
(Photo left)

THE FLO-RATOR is an instrument which constantly indicates the viscosity of a moving fluid. It consists of a cast iron body in the form of a conduit or flanged pipe section inserted in the pipe line through which the viscous liquids are being pumped. On top of the flanged section is a closed chamber with an inlet orifice which admits a small amount of liquid from the main flow. This chamber is also provided with an overflow or relief valve for maintaining constant pressure within the chamber, irrespective of fluctuations of pressure or temperature in the main conduit.

Liquid is then passed from the constant pressure chamber through another orifice to a metering tube. Varying resistance to flow of the liquid through this tube is indicated by static pressure reaction on a gage, the dial of which is calibrated in Saybolt seconds.

The sample of liquid passed through the Flo-rator may be returned to the fuel tanks by gravity, or admitted to a float-controlled receiver, from which it is returned to the suction side of the service pump.

Sterling Engine Co., Buffalo, N. Y.



Area Flow Meter

AN AREA type flow meter has been developed to meet the needs of measuring flow of heavy oils, chemicals and foodstuffs, which in the past has been difficult due to complex arrangement of piping and seals required between meter body and pressure taps when using standard differential orifice-type flow meters.

Seals and auxiliary piping between the meter body and pressure taps are not required by the area-type flow meter, because the meter body is installed directly in the pipe line.

The illustration shows the construction of the meter body which is of the piston and sleeve type. The flowing fluid enters the meter body, passes under the piston through the orifice, and is discharged.

As the fluid enters the meter body it strikes the bottom of the piston. Since the piston is free to slide vertically upward, it will be lifted, exposing a section of the rectangular orifice in the sleeve. As the fluid escapes through this orifice it rises to a pulsation throttling orifice in the vacant section above the piston. This exerts a vertical downward force on the piston, which will be equal to the area of the piston times the pressure of the fluid on the downstream side of the orifice.

The piston comes to rest when the force exerted upward on the piston is exactly equal to the opposing force, which will occur when the orifice is open sufficiently.

The position of the piston is definitely measured by an inductance bridge system as used in the Brown electric flow meter. As the armature travels vertically in the non-magnetic tube, surrounded by divided inductance coil, another armature in the receiving meter will assume a corresponding position which will be a measure of the area of orifice opening in the meter body, and hence the rate of flow.

Area-type meter is calibrated to give equal increments in deflection or equal increments in flow, hence the scales and charts are evenly graduated.

The meter-body is a complete unit in itself. No valves, seals, nipples, tubing, mercury or separate orifices required.

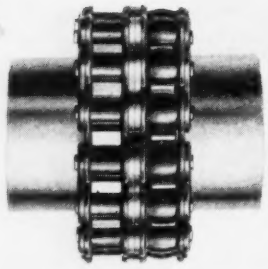
For measuring water, or fluids having approximately the same specific gravity, the ranges vary from 0-150 gal. per hour minimum, to 0-2,000 gal. per hour maximum. The meter is furnished only in 2-in. pipe size.

Brown Instrument Co., Philadelphia, Pa.

ZINC CHROMATE PRIMER

BERRYLOID is a new type of zinc-chromate corrosion-inhibiting primer for all varieties of metal surfaces, including dural and aluminum. Although it has an oil and synthetic gum base, it dries more rapidly than pyroxylin primer, and yet has the adhesion and waterproofing qualities not obtainable in lacquer base primers. It can be thinned 300 per cent for application by spray. When mixed with aluminum powder, it can be used as a dope proof paint and sealer to prevent bitumastic from bleeding into the finished coats.

Berry Brothers, Inc., 211 Leib St., Detroit, Mich.



FLEXIBLE COUPLING

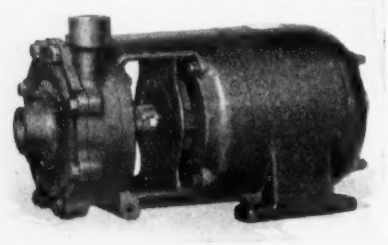
FLEXIBLE chain coupling designed to provide for free operation—without friction and excessive noise. This is accomplished by special double width roller chains. One strand of the chain is equipped with the standard cylindrical rollers, whereas the other strand has convex surface, oversize rollers which provide for free operations where shaft deflection and misalignment exist. Permanent shaft deflections up to 3 deg. can be handled without undue strains. Special heat-terated convex rollers operate freely on the hardened sprocket teeth without binding or undue wear. Bulletin No. 55 describes this chain coupling, as well as standard semi-flexible type.

Baldwin-Duckworth Chain Corp., Springfield, Mass.

TWO-STAGE CENTRIFUGAL PUMP

MONOBLOC 2-stage centrifugal pump advanced development is announced. The low-power requirements and simplicity make it applicable to services requiring small capacity and medium-discharge head. Casing designed for 150 lb. pressure, bolted directly to motor frame eliminates necessity for a baseplate. Unique impeller design consists of two enclosed-type impellers cast back-to-back. Overhung weight no greater than on a single stage pump. Reliability attained by motor with oversize grease-lubricated ball bearings. Impeller mounted directly on motor shaft, eliminating the additional space and weight of a coupling. Mounted vertically or horizontally. Pump has steep head capacity characteristics, for air-conditioning installations, refrigeration service, boiler return and chemical-process work.

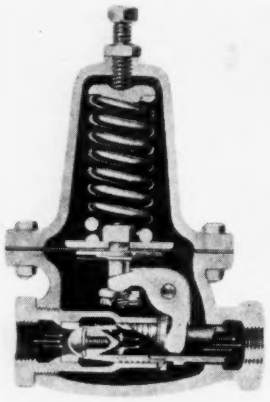
Worthington Pump & Mach. Corp., Harrison, N. J.



SHORT LENGTH BEARING BRONZE

MAGNOLIA bearing bronze bushings may now be obtained in short lengths from 2 to 14 in. long up to 7 in. outside diameter. The semi-finished bronze bar stock may be ordered to the exact size required, with sufficient extra metal to allow cleaning up to the sizes marked on the bars.

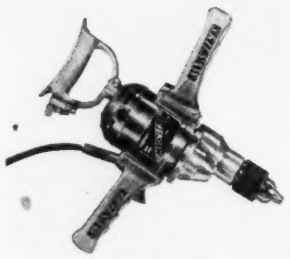
Magnolia Metal Co., 120 Bayway South, Elizabeth, N. J.



STREAMLINED REDUCING VALVE

THE VALVE proper has a blunt nose and a trailing edge, so that no matter how high the velocity, the trailing edge pulls no vacuum to retard flow, the purpose of streamlined contour being to insure maximum capacity. The conventional dividing wall is dispensed with: from inlet to outlet, the fluid flows through this valve in a straight line; hence there is no turbulence or hindrance to maximum flow. A jet extends into the outlet chamber. When demand increases, an accelerated flow through this jet produces an aspirating effect that lowers the pressure in the control chamber (below diagram) and thus opens the valve wide to meet peak demand. Closing against the pressure of the inflowing liquid this valve will not chatter.

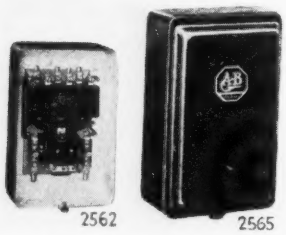
A. W. Cash Co., Decatur, Ill.



ELECTRIC DRILL

SKILSAW has added a new $\frac{3}{8}$-in. capacity drill to its line of ball-bearing electric drills. The new tool has especially designed motor which delivers substantially more power and is housed in a die-cast aluminum alloy body. It is compact and weighs 15 lb. Free speed is 500 r.p.m. Jacobs chucks are used. Switch is inclosed in Bakelite with patented snuff-arc construction.

Skilsaw, Inc., 3310 Elston Avenue, Chicago, Ill.



SOLENOID SWITCH

TWO NEW switches of 50 and 100 ampere ratings added to line of solenoid-operated starting switches. The new switches will handle polyphase motors up to 15 hp. and 110 volts, 30 hp. 220 volts, and 50 hp. 440 to 550 volts.

An arc hood completely inclose each contactor in an individual compartment from which arcing or heated gases cannot escape. The switch can disrupt ten times the maximum rated current at listed voltage. Double-break contacts dispense with flexible leads. Silver alloy contacts are provided.

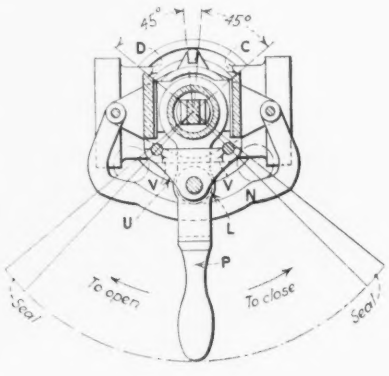
These switches close at as low as 70 per cent of rated voltage and will not drop open unless the voltage falls below 50 per cent of normal. Two new relays give protection against overload. Relays are of soldered ratchet type and can be reset without opening the cabinet.

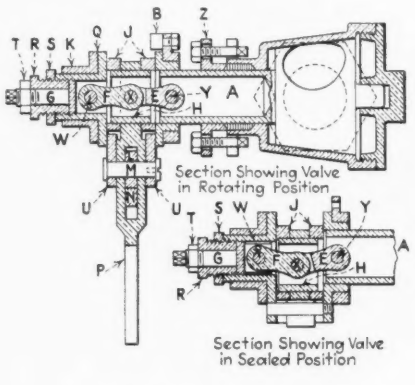
Allen-Bradley Co., 1311 South First St., Milwaukee, Wis.

THROUGH-FLOW VALVE

ADAPTED for steam, air gas and any fluid service lines to insure continuous flow. Seals tight open or tight shut, thus protecting seat rings against wear. Valve unseats axially before plug valve *A* is rotated; clearance readily adjustable from outside for any clearance of 0.01 to 0.06 in. No lubrication required. Furnished in 2-way, 3-way and 4-way designs of bronze, iron, steel and other metals, screwed or flanged ends in sizes $\frac{1}{2}$ in. and larger for all service pressures. Also furnished to operate with hand-wheel or for automatic operation in larger sizes. Diagram shows plug valve *A* unseated. As hand lever *P* is moved to open position, lug *D* on rotor *Q* contacts stop *B* to enable *A* to make a through-flow, concentric opening. On final movement of *P*, crank *U* oscillates on one pin *V* as roller *L* moves off its set arc, causing sleeve *H* to break toggle as shown in lower sketch and valve to seat axially and seal itself. When lever *P* is moved from open to closing, first movement of *P* causes roller *L* to come back to its position on arc and crank *U* to engage both pins *V* and sleeve *H* to straighten toggle and axially unseat *A*. As roller *L* travels its arc, *A* is rotated toward closing until lug *C* on rotor *Q* contacts stop pin *B*. As roller *L* moves off its arc, crank *U* oscillates on one pin *V*, causing sleeve *H* to break toggle and valve *A* to seat and seal closed.

Golden-Anderson Valve Specialty Co., Automatic Thru-Flow Valve Co. Div., Fulton Bldg., Pittsburgh, Pa.





PORT WASHINGTON NEARS COMPLETION

Port Washington plant of the Milwaukee Electric Railway and Light Co., the only new utility plant under construction, will have an initial capacity of 80,000 kw. in one tandem compound turbine served by one boiler supplying steam at 1,390 lb. pressure and 840 deg. F.

POWER LINES

Nation-Wide Power Pool Urged by P.W.A. Committee

FEDERAL regulation of the transmission of all electricity, regardless of the number of transmission lines that the government may ultimately own, was recommended by the Mississippi Valley Committee of the P.W.A. in a report presented to President Roosevelt on December 26. It urged unification of the country's entire supply of electricity under federal control, linking publicly and privately owned production in a system designed to promote economy and stability.

"There is nothing novel in the conception of a completely unified system for the generation and transmission of electricity," according to the report. "Over wide areas such unification exists. It should not be difficult to reconcile the public and private interests involved in including in such a system power from dams which are built primarily for the proper use and control of the nation's water resources."

"The legal and operating problems appear relatively trivial in contrast to the great social purposes to be accomplished."

"During the next twenty years," the report continues, "the federal government could probably spend a billion dollars on river works in the Mississippi Valley, half of which would be for self-liquidating power installations. With this nucleus, it could experiment as well as regulate."

Members of the Mississippi Valley committee were Morris L. Cooke, consulting engineer, Philadelphia, chairman; Harlan H. Barrows, chairman of the Department of Geography, University of Chicago; Herbert S. Crocker, consulting engineer, Denver; Lieut. Col. Glen E. Edgerton, Corps of Engineers; Henry S. Graves, dean, School of Forestry, Yale University; Major Gen. Edward S. Markham, chief of engineers; Charles H. Paul, consulting engineer, Dayton; Harlow S. Person, consulting economist, New York, and Sherman M. Woodward, Professor of Hydraulics, State University of Iowa.

The report recommended coordination of transportation, completion of navigation facilities on the main stream of the Mississippi and connections with the Great Lakes and establishment of a commission to regulate inland-water transportation.

In summarizing the conclusions of the report, the Public Works Administration stresses the importance of national control of water supply to insure purity, reduce natural hazards, reduce erosion, and make full use of waters for the purpose of power and recreation.

The original Mississippi Valley Committee was set up a year ago not only to recommend a broad plan of national power development but also a complete program of land-and-water control and use for the Mississippi basin, which includes 31 states.

Fuel Oil Standard Approved

The Bureau of Standards, Department of Commerce, announces that a new fuel oil standard will be effective on February 15, having been approved by a satisfactory majority of the industry. The specification, which will bear the title "Fuel Oils (Third Edition) Commercial Standard CS-12-35" is identical in substance with the tentative standard D396-34T of the American Society for Testing Materials.

Willis R. Whitney Wins Edison Medal

Willis R. Whitney, vice-president in charge of research, General Electric Co., has been awarded the Edison Medal for 1934, "for his contributions to electrical science, his pioneer inventions, and his inspiring leadership in research."

The Edison Medal was founded by associates and friends of Thomas A. Edison, and is awarded annually by a committee of 24 members of the American Institute of Electrical Engineers. The medal will be presented during the winter convention of the A.I.E.E. in New York, January 22-25.

Dr. Whitney's most notable achievement was the creation and development of the Research Laboratory of the General Electric Company at Schenectady. This laboratory, one of the earliest of its kind in this country, is today perhaps the best known industrial research laboratory in the world.

Among its thousands of contributions to technical progress are the tungsten lamp, the gas-filled lamp, new insulations and molded compounds, "Calorizing," "sheath wire," improved photo-electro cells, the Coolidge X-ray tube, atomic hydrogen welding, assistance in the development of high power turbines and the mercury boiler, a method of reclaiming crank-case oil. In addition there have been innumerable contributions in the field of pure science.

Dr. Whitney is past-president of the American Chemical Society and the American Electrochemical Society. He is a member or honorary member of numerous scientific and engineering societies.

Fuel Values Will Be Studied By New Joint Committee

Fuel values, particularly from the practical angle, are to be studied by the recently organized "Joint Committee on Fuel Values." The committee consists of a chairman and 16 members, 8 appointed by the American Society of Mechanical Engineers and 8 by the American Institute of Mining Engineers.

An outline of its program and policies, in a preliminary report, stresses the following:

"The Committee is convinced that it is impossible to set up any scale of values, or to devise any formula for general application, which will accurately reflect the relative values of different coals for steam generation. The Committee is of the opinion, however, that there is an opportunity for much con-

structive work in the collection, organization, and interpretation of *experience* data which will assist the individual consumer to establish his own scale of values to suit his particular circumstances and be helpful to the coal industry in the preparation of coal to meet a wide variety of consumer requirements.

"The Committee will study, on the basis of practical operating experience, the relation of individual coal qualities to the plant conditions which they affect, in order to establish, where possible, the limits within which under certain conditions specific coal qualities may affect the efficiency, operating cost and capacity; and to suggest methods by which the individual consumer can arrive at his own scale of values."

The personnel of the committee is particularly interesting, because of the practical viewpoint of the men involved and of the equal balance between consumers on the one hand and coal producers on the other hand. The membership follows:

Chairman: G. B. Gould, Fuel Engineering Co. A.S.M.E. Representatives: Alex D. Bailey, Commonwealth Edison Co., E. Drake Harkins, E. I. DuPont de Nemours & Co., F. M. Gibson, American Sugar Refining Co. (Secretary of Committee), James C. Hobbs, Diamond Alkali Co., A. L. Penniman, Jr., Consolidated Gas & Electric Light & Power Co., E. B. Ricketts, New York Edison Co., E. H. Tenney, Union Electric Light & Power Co., Edward H. Barry, West Virginia Pulp & Paper Co.; A.I.M.E. Representatives: H. F. Hebley, Allen & Garcia Co., Allen J. Johnson, Anthracite Institute, E. J. Kerr, Lorain Coal & Dock Co., R. S. Lane, Pocahontas Fuel Co. Inc., J. B. Morrow, Pittsburgh Coal Co., J. E. Tobey, Appalachian Coals, Inc., R. H. Williams, Island Creek Coal Co., Robert G. Pfahler, Berwind-White Coal Mining Co.

Blueprint for Recovery

(Continued from page 26)

ministrative agency of at least five members possessing the authority to approve or disapprove codes of fair competition in or affecting interstate commerce that have been voluntarily submitted . . .

The NIRA was a temporary measure designed to meet a national emergency, and it is recognized that its expiration would entail hardship in certain industries . . .

1. Any new legislation continuing the NIRA should be of the same temporary emergency character as the original act . . .

2. The continuance of present codes or the adoption of new codes should be conditioned upon voluntary action . . .

3. The new act should require every code . . . to contain suitable provisions concerning maximum hours and minimum wages, prohibiting child labor, safeguarding both labor and employer by giving to labor the right to deal with employers either individually or collectively, directly or through representatives of their own free choice . . .

. . . No code provision should be approved or continued which results in a price level burdensome and unfair to the public. . . .

Exhibitors Council Elects Officers

At the Annual Meeting of the Board of Directors of the Exhibitors Advisory Council in December the following officers were elected to serve in 1935:

President: N. O. Wynkoop, McGraw-Hill Publishing Co. Vice-President: E. J. Billings, The Babcock & Wilcox Co. Secretary: J. F. McNamara, International Nickel Co. Treasurer: J. P. Ferguson, Reading-Pratt & Cady Co., Inc. Executive Secretary: W. A. Hemming, Exhibitors Council.

The Exhibitors Advisory Council, which is entering its ninth year of show service to industrial and trade show exhibitors, is composed of important industrial companies interested in improving conditions relating to shows and exhibits. Comprehensive data and information, including show surveys and research, is maintained at headquarters, 330 West 42d Street, New York City.

Navy Buys Diesel Engines For Submarines

The U. S. Navy has just placed orders for 30 large diesel engines to be installed in five new submarines. The total cost of these engines and the electrical equipment they drive is $3,948,145. The orders were placed with two of the three manufacturers whose diesel engines are accepted by the Navy engineers.

Twenty of these engines are large units for propulsion service, while ten smaller units are for auxiliary service, generating electricity for operating all equipment aboard the vessels.

While diesel engines have been used in submarine service for many years, acceptance by the Navy of the lightweight, high-speed diesel engines now being widely used in transportation and marine service is significant because submarine service places the greatest importance upon absolute reliability of operation.

Eight of the large engines and four auxiliary units are of a type not previously built in this country. They are opposed-piston diesel engines furnished by Fairbanks, Morse & Co.

This type of engine has two pistons, an upper and lower in each cylinder, each connected to its own crank-shaft, one above and one below. Advantages claimed for this type of engine are improved combustion efficiency, extreme compactness and light weight.

M.A.P.I. Members Study Their Own Plants

A survey of potential machinery requirements in machinery building industry itself, now under way by the research division of the Machinery and Allied Products Institute, indicates so far that many millions of dollars worth of machinery would be purchased were confidence in government and business restored.

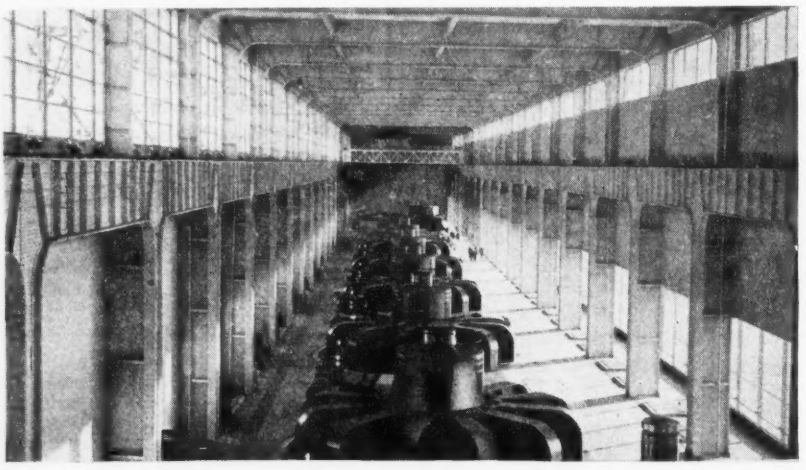
The questionnaire which M.A.P.I. has sent out to its 900 members of the machinery industry asks what each firm would be in the market for "with a sound Governmental policy and restored confidence." The survey segregates requirements into machine tools, electrical equipment (including power transmission, handling and service equipment) power plants and boilers, and miscellaneous equipment. It asks the total amount that would be spent on each type of requirement and whether or not it is for replacement or for increasing plant capacity.

M.A.P.I. has this to say about returns so far:

"The analysis of reports received indicates a wide spread on requirements—machine tools, power plants, electric power transmission. There is no question as to the encouragement to be secured from the factual data being accumulated. All trade groups could profit by similar surveys of their own industries. Millions of dollars worth of orders are dammed up.

DNIEPROSTROY GENERATORS EXCEED GUARANTEES

U.S.S.R. engineers have awarded General Electric Co. a bonus for exceeding its guarantees on the five generators for Dnieprostroy. Efficiency was 97.91% at full load (77,500 kva., or 62,000 kw. at 0.8 p.f.) on the best unit, average for all five 97.87%. These units are largest of any type now in service; each weighs 1,700,000 lb., with diameter 42 ft., height 40 ft. 5 in. over-all, 17½ ft. being above floor level



New York's Municipal Power Program Develops Three-Cornered Fight

FOR some weeks New York City has been the center of a dramatic power controversy that has all the appearance of a gigantic three-cornered poker game, the participants being the Consolidated Gas Co., (parent company of N. Y. Edison and other electric utilities in New York City), the New York City Government, and the Federal Government. Starting with a city drive against the utility for lower rates on current supplied to light municipal buildings and operate subways, it has quickly developed into an elaborate planning of municipal power plants, to be constructed with federal aid.

Developments have been extremely rapid and reports conflicting, each day's news presenting new angles and frequently carrying modifications of previous statements by the authorities concerned.

In general, there are two schools of thought as to what is taking place. One is that one or more of these municipal plants will actually be built and that the city will proceed to develop a portion, at least, of its power requirements. The other view is that the controversy is in the nature of a bluff, to force the utility, by vigorous threat of municipal competition, to reduce considerably its present electric bill to the city.

Since the whole situation is in a state of violent flux, it can perhaps be best presented in the form of a rapid review of the daily news developments, starting December 20. These will give some picture of the forces in conflict and the strategy of the combatants.

The "facts" announced may, of course, cease to be facts before this is published. Following is the running summary, day by day through Dec. 27.

Tuesday, December 18

Mayor LaGuardia, having refused to renew contract, carries the battle to Washington, confers with the President and enlists his support. Federal aid in the construction of a power plant for New York City is tentatively promised, providing the project proves to be economically sound. It is noted that the electric bill to New York City has been $14,000,000 a year, while the federal government pays $470,000 annually to illuminate and service post offices and other federal buildings in the city, apart from the Brooklyn Navy Yard, which operates its own plant. The Mayor explains to the President that New York City has been paying 5.84 cents per kw.-hr. for current to light its street lamps, while the city of Washington pays 2.2 cents.

LaGuardia talks with Secretary Ickes, P.W.A. Administrator. Ickes tentatively estimates the cost of a New York City plant at $15,000,000, of which the federal government would pay $3,250,000, the remainder to be a P.W.A. loan.

Discussing this, LaGuardia announces that the $15,000,000 will be just a starter, "comparable to bitters in a good cocktail."

It is also disclosed that the Navy Department has been conducting a rate survey in New York City, under the direction of Rear Admiral Ruben Bakenhus, who in 1918, under instructions from Mr. Roosevelt as Assistant Secretary of the Navy, built the Brooklyn Navy Yard power plant and cut yearly power costs from $900,000 to $300,000.

Friday, December 21

Mayor LaGuardia appoints a board of 14 city engineers to draw plans immediately. John H. Delaney is named chairman.

Maurice P. Davidson, commissioner of Water Supply, Gas and Electricity, says that the first unit of the proposed system may be in operation in March, to produce power to light city streets and public buildings from the Battery to 42nd St. He announces that federal engineers have been laying the ground work for the power program for six months. The Mayor refuses to commit himself when asked how soon the city system will be in operation. He expresses the opinion that the city has the legal right to use the utility conduits. He indicates that the system planned will supply light and power for subways, streets and public buildings. No contract has been signed for street lighting next year, he says.

Mr. Davidson has previously estimated that a city electric system would cost about $108,000,000, including transmission. The Mayor says he would be glad to take $15,000,000 for a starter.

Neither the Mayor nor Davidson is able at this time to estimate definitely the extent of the system, its cost, location of stations.

Sunday, December 23

Frank Smith, president of the New York Edison Co. and Commissioner Davidson continue a controversy. Smith states that the 1935 taxes of the Consolidated Gas Co. System amounted to more than $4.50 a share of common stock, whereas the stockholders received $2.00 a share. "You cannot promote recovery," Mr. Smith says, "by making war on the second largest industry in America and by crippling one of the largest tax payers in the city." "The issue", he concludes, "challenges the American tradition and the American form of government." In rebuttal Davidson accuses the Consolidated Gas Co. of holding up its electric rates to avoid damage to its domestic sales of gas.

Mr. Davidson reveals that the power-plant plans are gradually being broadened in scope. He says that the power supply, if the city goes into the business of selling to private consumers, will be provided through any one or a combination of the following methods: Purchase of current at wholesale, combination steam heating and generating plants, diesel plants, facilities in transit generating plants to be purchased by the city.

Monday, December 24

Now enters Frank P. Walsh, chairman of the State Power Authority, who thoroughly approves the move to build a municipal power system. Walsh promises that a special study of the New York rate system will be issued in a month or two.

LaGuardia attacks Smith's defense of the utility position. Mr. Smith is also attacked by Basil A. Manley, Vice-Chairman of the Federal Power Commission, who says, that Smith has "been setting up a straw man in order to knock him down again," in anticipating general distribution of power in competition with private companies. The tentative plan for the city to share a plant to supply the light and power needs in lower Manhattan contemplates no general distribution, he asserts.

Commissioner Davidson says the City's first move will be a thorough survey of needs for light, power and steam in at least one thousand of her three thousand public buildings, the survey to be made by relief workers and to require about two months. There is no possibility of a start on the construction of the first unit before late spring he explains. Davidson also indicates that he will have preliminary plans for a light and power system early in January.

Wednesday, December 26

Davidson reports that plans have been tentatively agreed upon for the city and the federal government to cooperate in building power plants and exchanging electric current. The plans, he says, call for a federal power plant near the general Post Office at Eighth Ave. & 34th St., Manhattan, to care for the light and power needs of all federal and city buildings in the mid-town area. In its turn, he says, the city may build a large plant in lower Manhattan to supply light and power for city and federal buildings in that part of the island.

Meanwhile the Mayor's committee of engineers considers means of making power from the excess steam from a new incinerator to be built at 46th St. and the Hudson River. The Mayor announces that the first city plant will be built at the Bronx Terminal Market, to take care of the market and nearby county buildings.

The plant, he states, will be located at 151st St. and the Harlem River. At present the County and Market buildings spend about $50,000 for light and power.

Commissioner Davidson says that no site has been chosen for the City's lower-Manhattan plant.

* * *

The foregoing covers news through December 26. The pace of events makes probable many further developments between that date and the mailing of this number of *Power*.

COMING MEETINGS

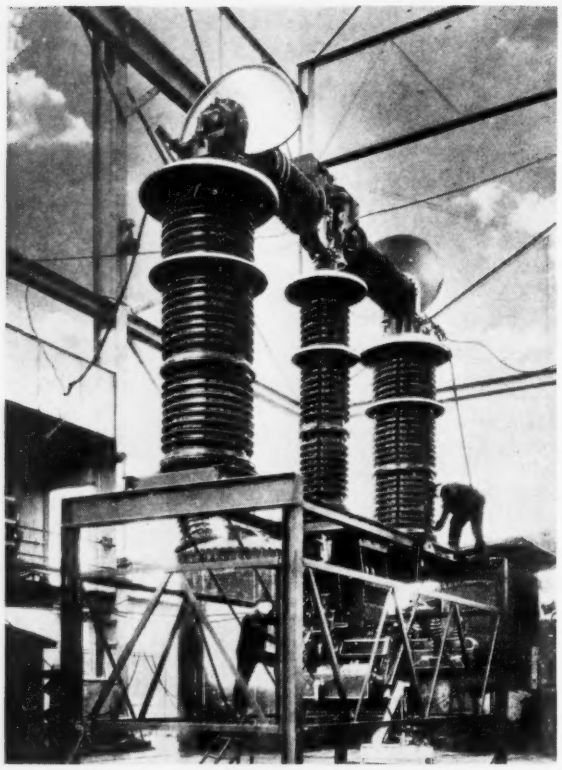
American Society of Heating and Ventilating Engineers—Forty-first annual meeting, Hotel Statler, Buffalo, N. Y., January 28-30. A. V. Hutchinson, Sec., 51 Madison Ave., New York.

American Institute of Electrical Engineers—Winter convention, Engineering Societies Building, 29 West 39th St., New York, N. Y., Jan. 22-25. H. H. Henline, Sec., 29 West 39th St., New York.

Engineering Institute of Canada—Annual general and general professional meeting, Toronto, Can., Feb. 7-8. R. J. Durley, Sec., Montreal, Quebec, Can.

Technical Association of the Pulp and Paper Industry—Twentieth annual meeting Waldorf-Astoria Hotel, New York, N. Y., Feb. 18-21. G. G. Macdonald, Sec., 122 East 42nd St., New York, N. Y.

American Engineering Council—Annual meeting of assembly and conference of secretaries of engineering societies, Mayflower Hotel, Washington, D. C., Jan. 10.



2,500,000 KVA. CIRCUIT BREAKER

One pole of a 2,500,000-kva., 287,500-volt, 60-cycle impulse oil circuit breaker for the Boulder Dam-Los Angeles line of the latter city. Eight triple-pole breakers will be installed, highest voltage breakers ever built for commercial use. Rated operating time is 3 cycles on a 60-cycle operating basis. Photo courtesy General Electric Co.

A.S.H.V.E. Meets in Buffalo

At the Hotel Statler, Buffalo, N. Y. the American Society of Heating and Ventilating Engineers will hold its 41st annual meeting January 28-30. Plans for the meeting are in charge of the committee on arrangements under the chairmanship of M. C. Beman. Of the technical papers to be presented at the five sessions the following will be of special interest to *Power* readers:

Some Recent Studies on the Ash in Coal, by Prof. T. G. Estep.

Cooling Requirements of Rooms in an Unconditioned Office Building, by F. C. Houghten and Carl Gutberlet.

The Nature of Ions in Air and Their Possible Physiological Effects, by Prof. L. B. Loeb.

The Thermo-Integrator—A new Instrument for the Observation of Thermal Interchanges, by C. E. A. Winslow and Leonard Greenburg.

The Heat Requirement of Buildings, by J. H. Walker and G. H. Tuttle.

Tests of Three Heating Systems in an Industrial Type of Building, by G. L. Larson, D. W. Nelson and John James.

Analysis of Studies on Heating an Office Building, by F. C. Houghton.

Brown Instrument Joins Minneapolis-Honeywell

The recent consolidation, whereby the Brown Instrument Company of Philadelphia became a subsidiary of Minneapolis-Honeywell Regulator Company of Minneapolis, unites two of the largest and oldest firms in the temperature control field.

Both companies are pioneers, the Brown Instrument having been established in 1860, while Minneapolis-Honeywell was organized in 1885.

Announces Mid-West Power Show

G. E. Pfisterer, Managing Director, Seventh Mid-West Engineering and Power Exposition, 1 N. LaSalle St., Chicago, Ill., has announced that the exposition will be held at Chicago, starting September 16, 1935, and that it will cover the important fields of power generation, distribution and utilization, including: power generation, electrical equipment, boiler room accessories and refractories, fuel burning, hydraulics, water softening, regulation and instruments, ventilating, cooling and heating, building and operation accessories, miscellaneous.

PERSONALS

G. S. Eldridge, consulting engineer, was chosen president of the Association of Professional Engineers of British Columbia at the annual meeting at Vancouver, B. C., recently.

P. H. Schaller, steam specialist of the Westinghouse Electric & Manufacturing Company, spoke on "Air Ejectors" at a meeting of the National Association of Power Engineers and the American Society of Mechanical Engineers, Louisville (Ky.) chapters.

J. R. Whitehead, manager, stoker and research divisions, Fairbanks, Morse & Co., Chicago, was elected president of the Stoker Manufacturers Association at the annual meeting held in Cleveland, Ohio, on December 10. He succeeds W. H. Rea, president, Detroit Stoker Co. R. B. McClave, President, McClave-Brooks Co., Scranton, Pa., was elected Vice President. Harry H. Kurtz, Iron Fireman Manufacturing Co., Chicago, was re-elected Treasurer and Marc G. Bluth, Chicago, was re-elected Secretary.

Wm. M. Gross has been appointed district sales manager in Ohio and eastern Michigan for International Filter Company, with headquarters at The Westlake, Cleveland, Ohio. He was formerly manager of the Water Treating Division of Graver Tank & Manufacturing Company.

E. E. Johnson, assistant engineer of the General Electric research laboratory, has been appointed engineer of the generator-voltage regulator department of the company.

H. W. Brooks, consulting engineer, who has been serving as assistant director of the electric rate survey under way by the Federal Power Commission, has resigned as of December 1 to return to consulting practice. Mr. Brooks was formerly a consultant for the governors of Ohio, Pennsylvania and New York in connection with the state institutions and has long been active in consulting work for industrial and utility concerns. For a long period he specialized in fuel research for the U. S. Bureau of Mines.

J. W. Sands, Development and Research Department, International Nickel Company, Inc., will be guest speaker at the January 10 meeting of the Worcester (Mass.) Chapter of the American Society for Metals and will discuss the value of nickel in increasing fatigue resistance and toughness of steel.

Robert F. McCloskey has been elected director and vice-president in charge of operations of the Blaw-Knox Company plants located at Blawnox, Pa., to replace Wayne Rawley, deceased.

A. Bair Bassoff, formerly production engineer of the Worth Steel Company and more recently consulting engineer of the Sier-Bath Company, has been appointed executive engineer of the S-B Gear Corporation, who will shortly place a complete line of speed reducers on the market.

Allan O. Summerville, assistant superintendent and electrical engineer of the distribution department of the Malden (Mass.) Electric Company, has been appointed superintendent of production.

OBITUARIES

Frank Clark Cosby, manager for the Standard Underground Cable Company for many years, with headquarters at Boston, Mass., died in Brookline, Mass., recently at the age of 64.

Alvan G. Lamb, chief engineer of the Webster generating station of the Webster & Southbridge Gas & Electric Company, an operated subsidiary of the New England Power Association, died recently. He had been chief at this plant for 11 years.

Ludger Jasmin, for 36 years connected with the plant operating department of the Burlington (Vt.) Light & Power Company, and on the retired list of the Green Mountain Power Corporation system since 1928, died recently.

Daniel J. Hasson, for 30 years a first-class steam operating engineer at the Chestnut Hill pumping station of the

Boston metropolitan water supply system, died at the Winthrop (Mass.) Community Hospital Dec. 5 after being struck by a train. He was born in Ireland in 1855 and was retired from the service of the metropolitan water board in 1925.

George Hawley, president of C. H. Sprague & Son, Inc., Boston, Mass., died suddenly of a heart attack Dec. 19. He was a past director of the Hawley School of Engineering.

Fred F. Stockwell, president and general manager of the Barbour Stockwell Company, Cambridge, Mass., manufacturers of trackwork for industrial power plants, manufacturing establishments and transportation agencies, died at his home in Somerville, Mass., Dec. 22 after an illness of three years. He was born in Brattleboro, Vt., in 1862.

Louis A. Anderson, for the past 26 years power plant engineer at the Connecticut State Armory, Hartford, died at the Hartford Hospital on Nov. 21. He was a native of Sweden.

Palmer C. Ricketts, 78, president of Rensselaer Polytechnic Institute, Troy, N. Y., and widely known educator, died Dec. 10. He was an honorary member of the American Society of Mechanical Engineers.

G. F. Brown, manager of the generator and converter division of the central station department of the General Electric Co. and for many years prominent in hydro-electric engineering, died Nov. 26 at Roxbury, Mass. For the past fifteen years Mr. Brown has specialized in the application of waterwheel generators.

Wayne Rawley, vice-president and director of the Blaw-Knox Co., died at Miami Beach, Fla., Nov. 16. Previous to his association with Blaw-Knox, Mr. Rawley was connected with the Carnegie Steel Co., the Cambria Steel Co. and the Pencoyd Iron Works in an engineering capacity. From 1902 to 1912 he was associated with the Riter-Conley Manufacturing Co. as manager of the Woods Run plant.

A. Bruck Fahnestock, inventor, consulting engineer and associate of Norman Bel Geddes, died of pneumonia on December 18. Mr. Fahnestock, about five years ago, became a consultant in the engineering department of Westinghouse and left that post to develop an automatic stoker of his own.

Milo Ketchum, Dean Emeritus of the College of Engineering, University of Illinois, died on December 19. Dean Ketchum was one of America's best known civil engineering professors and the author of many design books. At one time he was director of the Engineering Experiment Station, University of Illinois.

Wm. W. Macon, 59, for 14 years managing editor of "The Iron Age," died Jan. 1 of a cerebral hemorrhage. He had been ill for two years, his illness forcing him to resign as editor-in-chief of his paper after two years in that capacity.

BUSINESS NOTES

Beaver Pipe Tools, Inc., is the new name authorized by the Secretary of State for the organization formerly known as the Borden Co. The new name, chosen to identify the organization more closely with its products, involves no change in organization or products.

Republic Steel Corp., Youngstown, Ohio, has appointed the following three new warehouse distributors of Enduro Stainless Steel. Buhl Sons Co., Detroit; F. W. Heitmann Co., Houston, Texas; and the Woodward Co., Albany, N. Y.

Steel and Tubes, Inc., announces that the Tubular Service Corp. has recently begun to carry stocks of **Electrunite** boiler tube in its warehouses in New York and Philadelphia. Another New York distributor is J. B. Astell Co.

Reading Iron Co. announces the following promotions within its ranks: C. T. Ressler to Specification Engineer (401 N. Broad St., Philadelphia) R. I. Fretz to Manager of Eastern Railroad and Marine Sales (401 N. Broad St., Philadelphia) C. W. Guthrie to District Sales Representative for the Columbus territory.

The International Nickel Co., Inc., announces the appointment of David M. Curry to the development and research staff. He will devote his time to development work in the non-ferrous casting field, covering the entire range of foundry operation.

Republic Steel Corp. has appointed the Steel Products Co. of McKees Rocks, Pa., as warehouse distributors of Republic's Toncan Iron sheets in the Pittsburgh area.

Coal Specialties Co., 50 Church St., New York City, is distributing a computer which may be used by purchasing agents and others to determine the relative value of fuels.

United States Rubber Products, 1790 Broadway, New York City, has appointed Harry M. Green manager of Mechanical Goods Sales, Pacific Coast Division.

The Poole Foundry and Machine Co. has appointed Nibling Engineering Sales Co., 309 Colonial Bldg., Philadelphia, as their representatives for the sale of Poole flexible couplings and speed reducers in the Philadelphia District.

Worthington Pump & Machinery Corp., Harrison, N. J., has established a Pacific Coast regional headquarters at Los Angeles, to develop and handle the company's business in the western terrain now included in the coverage of the Worthington district offices in Seattle, San Francisco, Los Angeles and El Paso. E. C. Wilson, vice-president, will be in charge at 510 W. 6th St., Los Angeles.

Binks Manufacturing Co. of Canada, Ltd., has been organized as a subsidiary of the Binks Manufacturing Co. of 3106-50 Carroll Ave., Chicago, Ill. The company will handle sales and service of Binks Spray Paint Finishing Systems and Binks Water Cooling Systems in Canada.

Caterpillar Tractor Co., Peoria, Ill., has named C. Parker Holt executive vice-president, and Thomas J. Conner vice-president in charge of manufacturing and a director of the company.

American District Steam Co., North Tonawanda, N. Y., has appointed Tomlinson-MacLachlan, Inc., 1603 St. Clair Ave., Cleveland, Ohio, exclusive sales agents for Cleveland and Northeastern Ohio territory. They will handle the ADSCO expansion joints, condensation meters, steam flow meters, water heaters, steam traps, reducing valves, vapor heating specialties, underground steam line conduit and insulation and kindred equipment.

Babcock & Wilcox Co. has appointed E. R. Jefferson, 332 S. Warren St., Syracuse, N. Y., as agent for all Babcock & Wilcox refractories. Mr. Jefferson will cover twenty-seven counties in the central and central-western sections of New York State, as representative of B. & W. and several other nationally known manufacturers of industrial and power plant equipment.

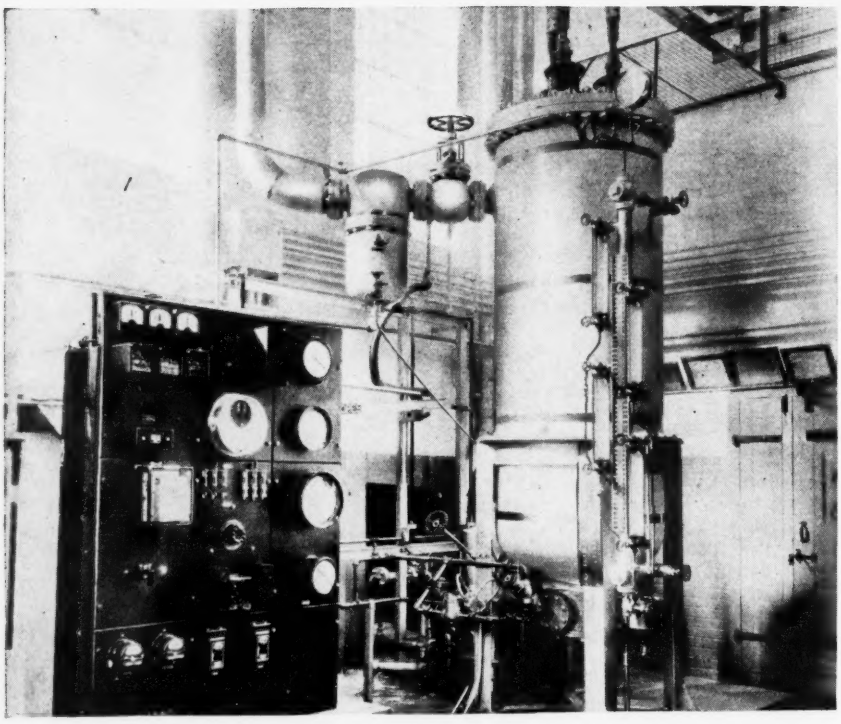
General Refractories Co., Philadelphia, Pa., announces the appointment of Collinwood Shale Brick & Supply Co., Cleveland, Ohio, as dealer-agents in the Cleveland area.

Canadian Atlas Diesel Engines, Ltd., (Victoria, B. C.) has been incorporated with capitalization of $50,000. Its papers show it to be operating as manufacturers of engines and machinery. Registered offices are at 314 Hall Building, 789 West Pender Street, Vancouver, B. C.

Ernest E. Lee Co., sales organization with offices at 53 West Jackson Boulevard, Chicago, has been appointed by the Coppus Engineering Corporation, Worcester, to handle the Coppus air filters for air compressors, internal combustion engines, industrial and ventilating applications.

John Reiner & Co., Inc., 29 Howard St., New York, N. Y., has been appointed distributor in that territory for Mason diesel engines of 10-60 hp. and 1-4 cyl.

United States Rubber Co. recently rushed three carloads of conveyor belts from Passaic, N. J., to the site of the Coulee Dam in the State of Washington. These belts, totaling more than 110,000 lb., were made up in Passaic (N. J.) plant of the United States Rubber Co. for Jeffrey Manufacturing Co., of Columbus, Ohio, for use in connection with equipment furnished Mason, Walsh, Atkinson, Kier Co., which has the excavation contract on the site of the Grand Coulee Dam. The excavation job on which the belts will be used entails the removal of approximately eleven million cubic yards of material.



ELECTRIC STEAM GENERATOR GOES DAIRYING

J. J. Joubert, Ltd., Montreal, Can., has installed this 2,000-kw., 10,000-lb. per hr. water-resistance generator, operating on hydro-electric power. Water being heated forms the resistance between three submerged electrodes. An extensive control system is provided, and it is possible to get steam up to 110 lb. in 15 min. Boiler efficiency is claimed nearly 98 per cent, overload rating is 60% (giving maximum of 300-325 hp.). Cast-iron electrodes 10 in. in diameter are set at the corners of a triangle within the 30-in. drum 10 ft. high. It replaces four 1,500-sq.ft. coal-fired boilers

STRAWS

Pointing the way business winds blow

Lyles Ford Tri-County Authority, Union, S. C., L. G. Young, Union, chairman, created by recent state legislative measure, has preliminary surveys under way for proposed hydroelectric power and irrigation project on the Encoree and Tyger Rivers. A series of dams will be constructed for water diversion, with main power dam in the vicinity of Lyles Ford. Generating plant will have initial capacity of 54,000 hp., and will include power substations and switching stations, transmission and distribution lines. Development will provide water supply for about 25,000 acres of land. Entire program is estimated to cost $8,500,000 and financing is being arranged through Federal aid.

Myerstown, Pa., is planning new municipal electric light and power plant. Application has been made for permission and hearings will be held by Public Service Commission early in January. Cost is reported close to $100,000, including distributing lines.

St. Marys, Ohio, has plans under way for extensions and improvements in municipal electric light and power plant, including installation of new boilers and other equipment. Capacity of station will be increased. Cost about $175,000.

Great Western Malting Co., Vancouver, Wash., recently organized, care of Galland-Benning Co., Milwaukee, Wis., engineer, plans one-story boiler house at proposed new multi-story malt plant on waterfront site secured from the Port of Vancouver. Cost over $300,000, with equipment. Peter Schmidt, Olympia, Wash., is one of heads of new organization.

Port Lavaca, Tex., has plans under way for new municipal cold storage and refrigerating plant, consisting of multi-story unit, with steam-electric power plant for operating service, latter to be equipped with Diesel engine-generator unit. Entire project will cost close to $150,000, and financing in that amount is being arranged through Federal aid. Garrett Engineering Co., Port Lavaca, is consulting engineer.

Duluth, Minn., has engaged Charles Foster, Sellwood Building, city, consulting engineer, to make surveys and recommendations for new central steam power house and distribution system for steam supply for heating service in the East End district. Entire project will cost over $3,000,000. Ernest A. Bodine is City Utilities Commissioner, in charge.

Ord, Neb., has plans under way for extensions and improvements in municipal electric light and power plant, including installation of new Diesel engine unit and auxiliary equipment. Proposed to ask bids in near future. Black & Veatch, Mutual Building, Kansas City, Mo., are consulting engineers.

Board of Freeholders, Newark, N. J., has plans nearing completion for extensions and betterments in steam-electric power plant at Overbrook County Hospital, Cedar Grove, to include installation of new generating equipment and accessories. Bids will be asked at early date. Fund of $125,000 has been secured through Federal aid. Runyon & Carey, 31 Fulton Street, Newark, are consulting engineers.

United States Engineer Office, Louisville, Ky., will receive bids until Jan. 15 for one 24-in. dredge pump unit, including spare parts.

Ontario Hydro-Electric Power Commission, Toronto, Ont., has approved plans for new power substation at Timmins, Ont., for power service in the Porcupine gold-mining district, including transmission line for connection with present power system. Proposed to have new station ready for service in the spring. Cost over $125,000.

Jacksonville, Fla., is considering a report submitted by the Taylor Engineering Co., Jacksonville, consulting engineer, for extensions and improvements in municipal electric light and power plant and electrical distribution system over a five-year period, totaling $2,454,000, of which about $854,000 will be used during 1935 and 1936. Work outlined includes now 25,000-kw. turbo-generator and accessory equipment for generating station, as well as a 1,500-hp. boiler and auxiliaries for steam department; new power substations and improvements in existing substations, installation of transformers and other equipment, to cost about $175,000.

Cummins Engine Co., Columbus, Ind., has just completed an addition to its plant of 85x250 ft., including two 30-ton cranes. This has been required by growing demand for the company's heavy-duty engines.

Pawnee, Okla., has ordered two 450-hp. McIntosh & Seymour diesel-generator units.

Inland Asphalt Co., Spokane, Wash., has purchased a 6-cyl. Caterpillar diesel for its crushing plant. F. R. Hewitt, Spokane, Wash., has purchased a similar unit for the same work.

Peverly Dairy Co., St. Louis, Mo., has added two 875-hp. Busch-Sulzer diesels to its steam power plant.

Department of the Interior has recently purchased two 6-cyl. Caterpillar diesels for Mt. Rainier National Park.

Columbus, Wis., has ordered a Nordberg diesel for its new municipal power and light plant. General contract went to H. B. Kilsofte, Winona, Minn.

Three municipalities in Alabama, Florence, Sheffield and Tuscombia, located in Northern part of the State, have plans maturing for construction of electrical distribution systems, to use power from the Wilson Dam development of the Tennessee Valley Authority at Muscle Shoals. Bids are scheduled to be asked at early date. Transmission

lines will be built by TVA to the district noted for furnishing service. Entire project will cost over $150,000, including power substation facilities.

Nevada Irrigation District, Grass Valley, Cal., has made application to the State Department of Public Works for permission to appropriate water from Clear, Fall, Texas, Trap and Rucker Creeks, all tributaries to the South Fork of Yuba River, to be used for a proposed hydroelectric power development. A series of diversion dams will be built to provide a water supply for total output of 223,640 hp., at main generating station. Program will include power substations and transmission line for service in different parts of the District.

Province of Quebec's production of electric power amounted to 1,009,596,000 kw. hr. in October last. The consumption of power in that province was 777,796,000 kw. hr., of which 326,539,000 kw. hr. was used by electric boilers.

Albert C. Lehman, president, Blaw-Knox Co., Pittsburgh, Pa., predicts a substantial revival in the heavy industries, in a statement just released. More than $5,000,000,000 worth of industrial machinery and power plant equipment must be bought to make up for the deferred maintenance, he points out, according to estimates of the Durable Goods Committee. Resumption of the delayed buying by the public utilities for maintenance and replacement material, plus the potential market which will be created by public utility expansions, offer a substantial outlet for the products of the Durable Goods Industries.

Bureau of Reclamation, Denver, Colo., will receive bids until Jan. 21 for quantity of switching, relaying and metering equipment for 2,300 and 16,500-volt service at Boulder power plant, Boulder Canyon Project, California-Nevada-Arizona, including distribution and control switchboards, control cubicles, thermal panels and accessories (Specifications 601).

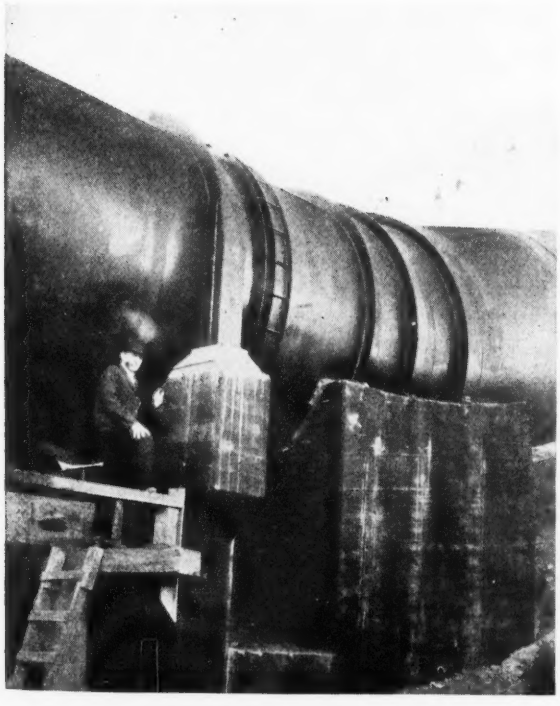
Colgate-Palmolive-Peet Co., 105 Hudson Street, Jersey City, N. J., has filed plans for new one-story power plant at local soap factory, including improvements in present station and installation of new equipment. Work will be carried out in connection with general expansion and improvement program at factory, entire expenditure totaling close to $500,000, with equipment.

Grand Haven, Mich., is completing plans for extensions and betterments in municipal electric light and power plant, with installation of new electric and steam equipment. Bids will be asked soon. Work is estimated to cost approximately $75,000. Hamilton & Weever, Grand Rapids, Mich., are consulting engineers in charge.

Cone Ice & Cold Storage Co., Red Bluff, Cal., a subsidiary of the National Ice & Cold Storage Co., San Francisco, has plans for new addition to ice-manufacturing plant. Cost estimated over $40,000, with equipment. Company engineering department is in charge. M. W. Young is company manager at Red Bluff.

Anderson, Mo., will hold a special election in January to approve bond issue of $55,000, fund to be used for construction of a municipal hydroelectric generating plant, with oil-operated station for standby unit. Proposed to ask equipment bids closely following. Albert C. Moore, Joplin, Mo., is consulting engineer.

Darlington, Wis., is considering construction of new municipal electric light and power plant, and plans call for bids for equipment early in 1935. It is estimated to cost about $125,000, with equipment. James Van Sleet, Darlington, is engineer.



QUARTER-MILE TUBE

Two huge siphons, one 10½ ft., one 9 ft. in diameter, will form part of the North Canal in the Mitchell Butte diversion, Owyhee project of the Federal Government. The 9-ft. tube is being welded into a single section 1,630 ft. long, the 10½-ft. tube into a section 900 ft. long. The photograph shows a close-up view of the expansion joints and anchors on the Sniveley siphon. Photograph courtesy Lincoln Electric Co.

Northern British Columbia Power Co. as an initial step in its power extension program has placed a contract with Stewart Cartage Co. for the removal of the diesel plant from Dunwell to its new site on the Stewart-Hyder road. Ultimate development may run to $91,500, and will include installation of a second diesel unit costing approximately $30,000 and development of other power units at Portland Creek and Barney's Gulch, according to the tentative program announced by Manager J. J. Little earlier this fall.

Cumberland, B. C., has decided to introduce a by-law relinquishing all claim by the City Council to the property and privileges of the Cumberland Electric Lighting Co. and the granting to the company of the right to complete their term of franchise.

Cariboo Hydroelectric Company will start, in the spring, to build the Cariboo hydroelectric plant on the Swamp River, according to Dr. W. B. Brunett, president of Cariboo Gold Quartz. The new power plant will have an initial capacity of 5,000 hp. Capital for the project amounting to $1,000,000 is already available.

Vancouver (B. C.) City Council has received plans for the central heating plant to serve wards one and two from H. A. Flood and Associates of Tacoma, Wash., promoters of the project. The plans have been referred by the Council to City Engineer Charles Brakenridge, who will examine them and report back to the aldermen.

Premier Mine, Stuart, B. C., will build a new power plant with a steel frame structure. Crews are working on the clearing and grading of the site, which is located a little above the old plant, recently destroyed by fire. The proposed building will be approximately 50 by 70 ft., it is understood. About 1,800 hp. will be developed in the new plant, but no decision has yet been made as to the type of equipment to be installed.

Knoxville, Tenn., has received, from Burns & McDonnell Engineering Company of Kansas City, plans for the city's proposed municipal power distribution system, which will use electricity purchased from the Tennessee Valley Authority. Knoxville lately resumed plans to build and own distribution system with a $2,600,000 loan and grant from the public works administration after a court suit halted plans of the Tennessee Valley Authority to purchase the local power company's properties and turn them over to the city for operation.

City of Canandaigua, N. Y., has engaged Lewis C. Reynolds, consulting engineer, to make a survey and report on the establishment of a municipal electric plant and system for that city. Preliminary surveys indicate that the complete system will cost approximately $300,000 and require a plant of about 1,500 kw. The final survey will probably change these figures somewhat. Diesel engines, steam and purchased power will be considered. The city has a population of 7,500.

NEW BULLETINS

Packings, Lubricators, Soft Mallets — Greene, Tweed & Co., 109 Duane St., New York, N. Y. 64-page catalog No. 16 includes data on this company's well-known brands of packing, "Favorite" reversible ratchet wrench, "Basa" soft-faced hammer, "Empire" rawhide mallet, "Rochester" automatic lubricator, belt fasteners, walrus and other polishing leathers, and general engineering information.

V-Belts—L. H. Gilmer Co., Tacony, Philadelphia, Pa. V-Belt Catalog JS-215 for multiple-groove and fractional horsepower drive.

Unit Heaters — Fedders Mfg. Co., 57 Tonawanda St., Buffalo, N. Y. 8-page Bulletin 527 describes Series 3 unit heaters, including typical piping diagrams.

General-Purpose Meters—The Foxboro Co., Foxboro, Mass. 6-page folder "I've Waited Years for a Meter Like This One" gives data on new meters for universal application.

Small Circuit Breakers—I-T-E Circuit Breaker Co., Philadelphia, Pa. 6-page Bulletin 634, "Itelite," describes small thermal circuit breakers available in capacities suitable to protect commercial wire from 15 to 600 amp., and voltages up to 250 d.c., and 600 volts a.c.

Regulators—Smoot Engineering Corp., 2240 Diversey Parkway, Logan Square Station, Chicago, Ill. 24-page "Smoot Regulators," Catalog No. S-10, contains complete data covering applications, principles of operation and construction of these units.

Vacuum Pumps — Roots-Connersville Blower Corp., Connersville, Ind. 4-page Bulletin 50-B11 describes vacuum pumps for high-duty use and various units of paper-mill equipment.

Shaftless Motors—Louis Allis Co., Milwaukee, Wis. 8-page Bulletin No. 516 describes and illustrates various types of shaftless motors, construction and electrical characteristics.

Refractoy Products—Plibrico Jointless Firebrick Co., 1800 Kingsbury St., Chicago, Ill. 32-page general catalog covering jointless firebrick and other refractory products. Excellently illustrated.

Sheet Iron—Republic Steel Corp., Central Alloy District, Massillon, Ohio. 8-page folder, "Thumbs Down on Rust," gives three reasons for high rust resistance of Toncan copper-molybdenum iron, and illustrates typical installations of sheet iron. Bulletin No. ADV-132.

Centrifugal Pumps—Lawrence Pump & Engine Co., P. O. Box 70, Lawrence, Mass. 4-page folder describes centrifugals in two, four and six stages for heads up to 1,200 ft., all horizontally split casing type suitable for electric, motor-belt, steam turbine or internal combustion engine drive. Speeds to 3,600 r.p.m. Folder D-15.

Abrasives—Norton Co., Worcester, Mass. Attractive 28-page, easy-to-read bulletin, "Abrasives, Their History and Development." Also 8-page bulletin, "Norton Bortz (Diamond) Wheels."

Stainless Steel — Crucible Steel Co. of America, Chrysler Bldg., New York, N. Y. 82-page Section 3 of catalog, "Corrosion and Heat-Resisting Steels," gives unusually extensive data on all types, including much engineering information, typical installations, machining and fabricating data—even a comprehensive index.

Baffling—Power Plant Efficiency Co., 702 Union Title Bldg., Indianapolis, Ind. 2-page Bulletin No. 26, "Select Your Boiler Baffling Carefully," gives some engineering information.

Turbo-Blowers—Allis-Chalmers Mfg. Co., Milwaukee, Wis. 4-page leaflet No. 2180, "Single-Stage, Geared-Head Turbo-Blowers," for oil and gas-fired furnaces, featuring compactness, simplicity, low waste and high efficiency.

Gas Engines—Worthington Pump & Machinery Corp., Worthington Ave., Harrison, N. J. 6-page Bulletin S-550-B6 on Vertical Four-Cycle Type CG Engines.

Boilers—Henry Vogt Machine Co., 10th and Ormsby Sts., Louisville, Ky. Series of boiler bulletins covering company's three-drum and four-drum curved-tube boilers. Each bulletin illustrates recent representative installations.

Electrical Equipment — Allen-Bradley Co., Milwaukee, Wis. Extensive series of price sheets for revised catalogs on all types of electrical equipment.

NEW PLANT CONSTRUCTION

McGraw-Hill Business News Department Is Prepared to Furnish a More Complete Daily Service

Ark., Harrison—City, R. Worthington, mayor, election in January, municipal light and power plant, equipment, etc. Population about 4,000.

Calif., Fresno—Municipality received offer of National Eng. Co., engrs., 4573 West Pico Blvd., Los Angeles, to construct electric power plant and distribution system and take revenue bonds to be paid from earnings as payment.

Calif., Napa—City Council making surveys engaging engineer to make report on cost to acquire or construct municipal light and power plant.

Calif., Redding—City, E. E. Dick, city supt. of electricity, recommends to City Council construction of Diesel or steam operated plant for city electrical system. City has been purchasing power from private concern. Surveys to be made.

Ind., Richmond—Municipal Lighting & Power Co., D. C. Hess, supt., appropriates $40,300 funds for 1935 material and equipment, incl. meters, transformers, short extensions, sundry equipment for underground construction.

Ind., Wabash—City plans electric light plant on site south of Wabash River. Management & Eng. Co., 327 South LaSalle St., Chicago, Ill., engrs.

Ia., Bottendorf—City Council, G. Schmann, mayor, has taken initial steps toward construction of municipal light and power plant. Report of committee who investigated costs and inspected plants in Iowa and Illinois submitted.

Ia., Sheldon—City plans new bond election for power plant, $240,000. H. L. Cory, Baum Bldg., Omaha, Neb., engr.

Ia., Shenandoah—Bids Jan. 21, by City, constructing power plant, power house, sinking new well, extending and improving waterworks system. $55,000. P.W.A. project. Allen & Vagtborg, Inc., 205 Wacker Dr., Chicago, Ill., engrs.

Mass., Northampton — Commonwealth of Massachusetts, Dpt. Mental Diseases, State House, plans being completed by M. W. Maloney, 220 Dwight St., Springfield, and takes bids in January for 3 story, 40x125 ft., food storage unit, incl. cold storage equipment, $81,000. Edward C. Brown Co., 77 Summer St., Boston, engrs.

Mich., Allegan — City completing plans for dam and hydro-electric power plant for municipal power system, incl. rein.-con. dam across Kalamazoo River and power house. $410,000. P.W.A. project. Objection and litigation to project have been dropped by Consumers Power Co. Ayres, Lewis, Norris & May, Ann Arbor, engrs.

Mich., Benton Harbor—City plans by D. Lakie, Grand Rapids, 4 story, rein.-con., brick, rein.-con. cold storage plant, plain found. $238,000. P.W.A. project.

Minn., Spring Valley—Village, J. N. Osterud, city clk., plans power plant and electric distribution system. $45,000 bond voted.

Miss., Jackson—City, election Jan. 19, $1,500,000 bond issue to provide funds for building municipal power plant and distribution system.

Miss., Pelachatchie—Pearl River Valley Lumber Co., plans lumber mill and power house. To exceed $50,000. Architect not appointed.

Mo., Anderson—City election Jan. 8, $55,000, hydro-electric plant, oil engines. A. C. Moore, P. O. Box 305, Joplin, engr.

Mo., Independence—City withdrew bids to have been opened Dec. 20, constructing brick, concrete power plant. Black & Veatch, 700 Mutual Bldg., Kansas City, engrs. New date not decided.

Neb., Bayard—Morrill County Hydro-Electric Co., Bayard, making preliminary survey and study for taking water from North Platte River through Nine Mile Canal and utilizing water from 9 mi. drain and Hoth Canyon drain making 700 kw. generating capacity hydro-electric project. Henningson Eng. Co., 326 Union Bank Bldg., Omaha, engrs.

Nev., Boulder City—Bids Jan. 21, by Bureau Reclamation, Denver, Colo., main control equipment, battery charging sets, battery control switchboard, 250-volt direct current distribution switchboard, 460 volt and 115 volt alternating current control equipment and miscellaneous 2,300 volt and 16,500 volt switching equipment, for Boulder Power Plant, Boulder Canyon Project, Arizona-California-Nevada.

Nev., Winnemucca—City voted $306,000 for municipal water and light system. P.W.A. project.

N. Y., Auburn—City, K. Bowen, mayor, plans submitting project to voters on bond issue to construct municipal light and power plant, incl. diesel engines and street lighting system, $310,000. P.W.A. loan disallowed. **Maturity 1935.** Burns & McDonnell Eng. Co., 107 West Linwood Blvd., Kansas City, Mo., engrs.

N. Y., Lockport—City, D. J. Thurston, mayor, plans municipal hydro-electric plant, $908,000. Will submit proposition to voters at November, 1935, election. P.W.A. project. L. A. Harding, Prudence Bldg., Buffalo, engr.

N. C., Winston Salem—City, plans constructing municipal power plant, George W. Coan, mayor, Winston Salem, pushing proposal to supply city's needs.

O., Cleveland—Fairview Park Hospital, H. Schmitt, chn. Building Comn., 3305 Franklin Ave., plans power plant, laundry, etc., 3305 Franklin Blvd. $150,000. Architect not appointed.

O., Germantown—Germantown Distillery Co. plans by Walker & Norwalk, archts. and engrs., American Bldg., Dayton, altering power house and distillery. To exceed $30,000.

O., Grafton—Village, E. H. Arnold, pres. Bd. Affairs, plans light plant. P. W. Elwell, engr., 5005 Euclid Ave., Cleveland, preparing survey.

O., Niles—City Council, plans appropriation of $1,500 for survey of plans for municipal electric light and power plant.

O., Sandusky—City Comn. revising plans and specifications for construction municipal light plant, application for P.W.A. loan and grant, $1,400,000. Froelich & Emery, 2nd Natl. Bank Bldg., Toledo, engrs.

Pa., Sharon—City Council sketches municipal light and power plant. **Maturity indefinite.**

Pa., Warren—City retained P. W. Elwell, engr., 5005 Euclid Ave., Cleveland, O., to prepare survey for light plant.

R. I., Pawtucket—Municipality, A. Lamarre, comr. P. Wks., in charge, plans electric power plant, Pleasant St. To exceed $40,000. **Maturity indefinite.**

South Carolina—Lyles-Ford Tri-County Authority, L. G. Young, chn., Union, will apply for P.W.A. loan to finance construction 4 large dams, 1 at Whitmire, one across creek in Goshean Twp., one on Tiger River and one near Lyles Ford, 3 of dams will be 96 ft. high, to create poundage of 25,000 acres and develop 54,000 hp. in Newberry, Union and Fairfield Counties, $8,500,000. Preliminary work being actively carried on necessary for application to P.W.A.

Tex., Port Lavaca—City submited plans to P.W.A. State Bd. for refrigeration unit, cold storage plant, oyster and shrimp storage facilities, diesel power plant, etc., incl. complete machinery equipping. $150,000. P.W.A. project. Garret Eng. Co., Port Lavaca, and 300 Hughes St., Houston, engrs.

Va., Bristol—East Tennessee Light & Power Co., plans repairing steam power plant. To exceed $150,000.

Alta., Calgary—Calgary Power Co., Ltd., making plans and takes bids in spring, addition to plant. $150,000.

B. C., Vancouver — Cariboo Hydro-Electric Power Co. Ltd., 902 Royal Trust Bldg., plans hydro-electric plant to supply power to Cariboo Mines. A local engineer will be appointed soon. Company incorporated for $1,000,000. Surveys have yet to be made.

Man., Winnipeg—Manitoba Power Comn. preparing plans and takes bids early in 1935 hydro extension to Red Valley Dist.

Ont., Kenora—Hydro Electric Comn. of Ontario, Toronto, plans hydro-development at Lake St. Joseph. To exceed $250,000.

Que., Montreal—City Engineer preparing plans municipal power house on aqueduct canal. $3,000,000.

Que., St. Anne de St. Anselme—L. Couture, making plans power generating plant on Etchemin River and distribution system in Dorchester County. $150,000 (initial).

Sash., Leroy—Town plans by I. F. Spicer, for construction of electric plant.

Tasmania, Hobart — Government preparing plans and takes bids early 1935, constructing 88,000 hp. capacity hydro-electric development at St. Clair Lake on Derwent River. $2,945,000.

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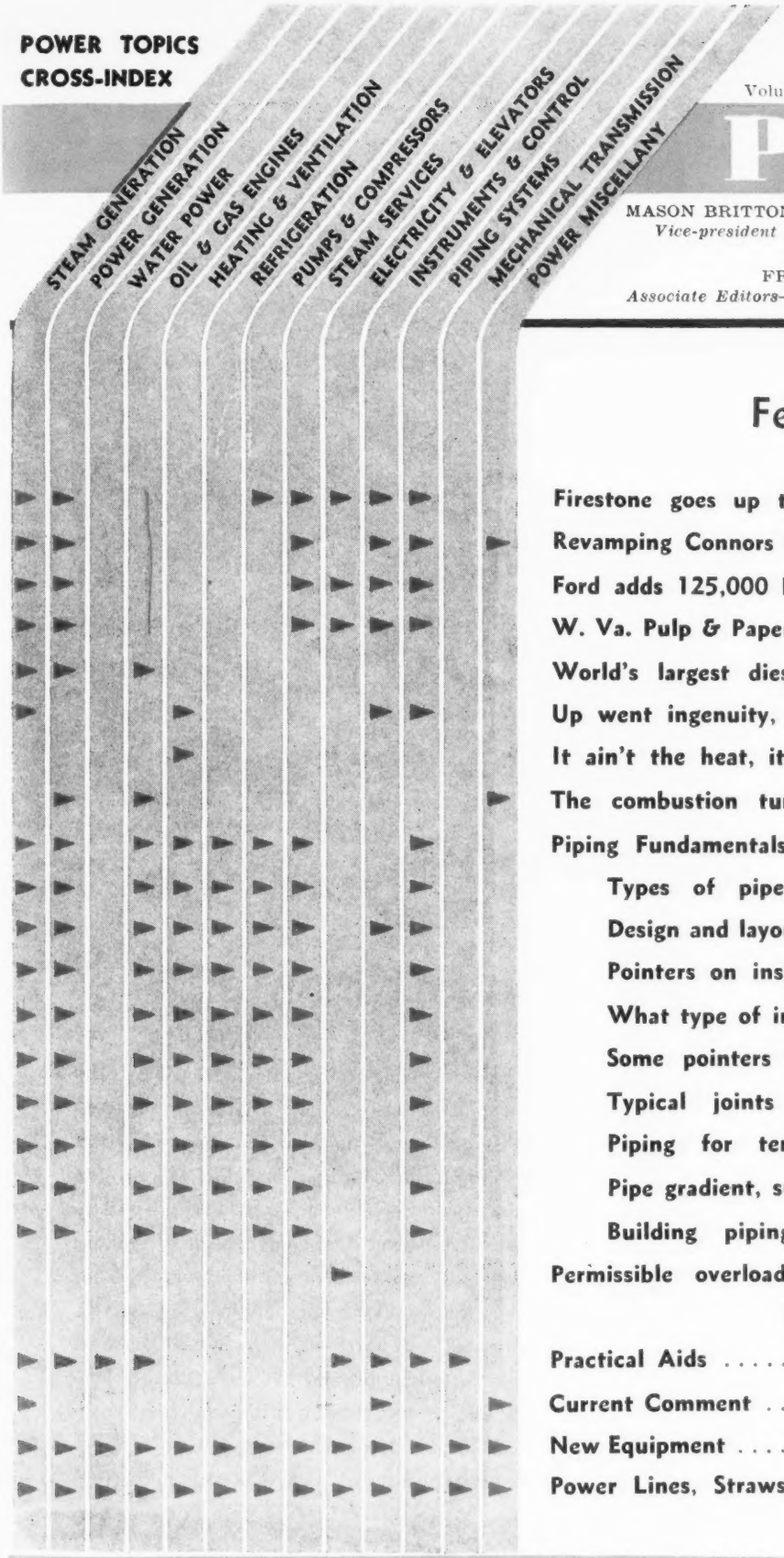

Volume 79 Number 2

POWER

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McGRAW-HILL PUBLISHING COMPANY, INC., 330 WEST 42d STREET, NEW YORK, N. Y.

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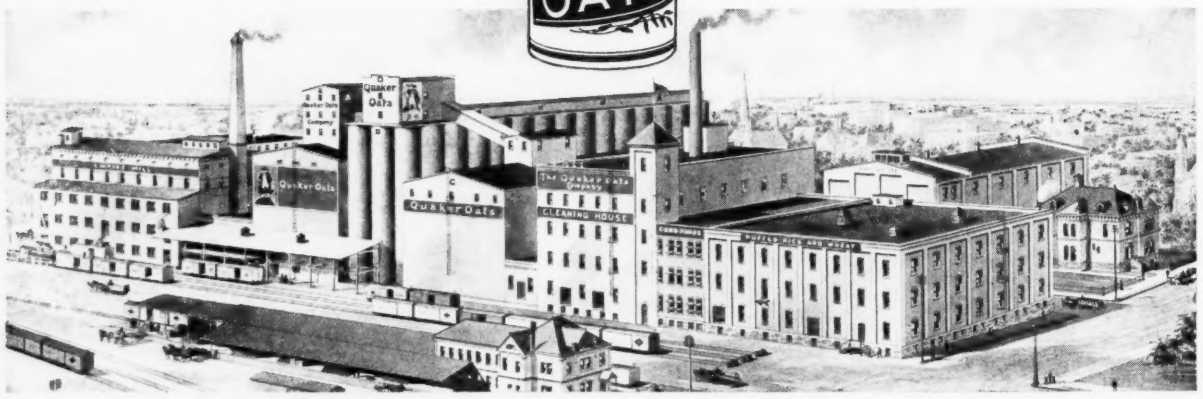

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